SYSTEM OPERATIONAL REQUEST: #2021-6

WALLA WALLA DISTRICT

The following State, Federal, and Tribal Salmon Managers have participated in the preparation and support this SOR: Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Nez Perce Tribe, Yakama Nation, Warm Springs Tribe, Spokane Tribe of Indians, and the Columbia River Inter-Tribal Fish Commission/Confederated Tribes of the Umatilla Indian Reservation.

TO:	Brig. Gen. Pete Helmlinger	COE-NWD-ZA Commander
	Lt. Col. Rick Childers	COE-NWW Commander
	Jim Fredericks	COE-NWD-PDD Chief
	Steven Barton	COE-NWD-PDW Chief
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	Jason Sweet	BPA-PGB-5
	Eve James	BPA-PGBO-5
	Tony Norris	BPA-PGPO-5
	Scott Bettin	BPA-EWP-4
	Paul Cloutier	COE-NWD Tribal Liaison
	Dean Holecek	COE-NWW Tribal Liaison

FROM: Charles Morrill, FPAC Chair

DATE: September 14, 2021

SUBJECT: Snake River Zero Nighttime Flow

SPECIFICATIONS: The fishery managers recommend restored application of Zero Nighttime Flow limitations and criteria (date and abundance), implemented prior to the 2020 CRS

Biological Opinion, at the Snake River projects. This year's extremely low steelhead return will result in a threshold of 10 adult steelhead passing Lower Granite Dam as "few, if any" actively migrating anadromous fish after December 1.

JUSTIFICATION: Zero nighttime flow operations at federal projects in the Lower Snake River have been the subject of much discussion since the dams were completed. Decades of discussion culminated in limiting Zero Nighttime Flow operations to periods after December 1 and through February 28 "when there are few, if any, actively migrating anadromous fish present in the Snake River" in Water Management Plan Seasonal Updates beginning in 2004. Fish managers defined "few, if any" in SOR 2005-22 and the criteria in this definition have guided and governed implementation since then. However, zero nighttime flow operations do not support normal ecological river functions and as such are not supported by all fish managers. In addition, 2021/22 Snake River steelhead returns are at extreme low levels, continuing a trend of returns that has multiple populations at or below Quasi-Extinction Thresholds. In response, the State of Washington has closed steelhead harvest in the Snake River downstream of Lower Granite. There is limited to no real monitoring of this operation and with low numbers of PIT-tagged adults it is unlikely effects of operation can be determined.

SOR 2020-6 made this same request last year, with TMT discussions occurring at the September 30, 2020 meeting. Action Agencies (AA) decided not to implement the SOR as it was outside the scope of operations included in the Columbia River System Operations (CRSO) Biological Opinion and Record of Decision (ROD) and its implementation would be limited and consistent with recent years. The AA noted that implementation would be monitored and if implementation varied greatly from NOAA's expectations, follow-up conversations would occur. NOAA coordinated sub-group conversations to discuss monitoring, which have not produced any monitoring recommendations or updated impact assessments to date. The AA TMT decision was elevated to RIOG, with no change in Action Agency position.

Summaries of zero flow operations implemented from October 15, 2020 through February 28, 2021 are available in the 2021 Water Management Plan Seasonal Update (http://pweb.crohms.org/tmt/documents/wmp/2021/Seasonal_Update/20210604_2021_WMP_SU_2.pdf) and in Fish Passage Center memorandum 64-21. In addition, Bonneville Power Administration has contracted University of Washington to analyze PTAGIS data for fish effects. Some preliminary results were shared at the January 20, 2021 TMT meeting, however, the University of Washington analysis is still being reviewed by federal agencies and those materials will not be shared until they are finalized.

Application of previously established abundance-based criteria would have allowed availably of zero flow operations starting December 5, 2020.

Between October, 2020 and February, 2021, a total of 938 hours of zero flow conditions were created with the lower Snake River, with stoppage of flows at individual projects ranging from 164 to 279 hours. Actual implementation between October 15 and December 4th is summarized in Table 1.

Table 1. Summary of zero flow operations at lower Snake River projects between October 15 and December 4, 2020. Modified from FPC memorandum 64-21.

	Lower Granite	Little Goose	Lower Monumental	Ice Harbor
Initial date of implementation	October 19	October 19	October 19	October 19
Number of implementation periods	18	19	18	10
Total hours of zero flow	80	88	82	41
Number of periods with consecutive days	4	4	5	3
Number of periods exceeding 1 out 3 day/1 out of 5 day frequency	12/14	13/16	12/15	5/6

Background

The operation in the 2020 CRSO Biological Opinion and the ROD removed the steelhead abundance criteria and formalized an October 15th start date (Page 65, Section 1.3.1.3.) and described frequency of expected operations (Page 68, Section 1.3.1.3.3). The 2021Water Management Plan does not include fish-based zero flow implementation criteria and extends the zero flow operation period by 45 days:

> *"Between October 15 and February 28, when power market conditions warrant and when river conditions make it feasible, power generation at Snake River projects may cease, and water stored, during nighttime hours, most commonly implemented between 2300 and 0500 hours when demand for power is lowest or other renewable resources are generating surplus power (or both). This operation will end no later than 2 hours before dawn between October 15 and November 30. During the operation between December 15 and February 28, daytime hours will no longer be excluded from this operation, and up to 3 hours of daytime cessation will be part of the proposed action."*
>
> "*The timing and need for ceasing power generation during this period is difficult to predict. However, based on previous operations between December 15 and February 28 and during nighttime hours only, BPA estimates that the use of this operation may occur 1 out of every 3 to 5 days at each project."*

Dropping implementation criteria and implementing zero flow operations earlier would allow river flows in the Lower Snake River to be shutoff for up to 25% (6 hours) of each day (37.5% or 9 hours after December 15) for 4.5 months, even during periods of known significant adult and juvenile passage.

Zero nighttime flow is a load-following operation, often referred to as “peaking”, where water is stored during periods of low power demand and subsequently released when demand is high. Little definitive information on the impacts of peaking on anadromous fishes in the Lower Snake River exists and is largely limited to upstream migrating adults, with no analysis of the impacts on juveniles. Furthermore, it is difficult to predict the impacts of the new zero nighttime flow operation because of the flexibility afforded to the Action Agencies — it can occur every day or very seldom. No study completed to date indicates that zero flow operations benefit fish passage or protection measures.

Impacts on Adults and Juveniles

See SOR 2020-6 (attached) and RIOG Elevation Memo (attached).

SYSTEM OPERATIONAL REQUEST: #2020-6

WALLA WALLA DISTRICT

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	Scott Bettin	BPA-EWP-4
	Paul Cloutier	COE-NWD Tribal Liaison
	Dean Holecek	COE-NWW Tribal Liaison

FROM: Dave Swank, FPAC Chair

DATE: September 22, 2020

SUBJECT: Snake River Zero Nighttime Flow

SPECIFICATIONS: The fishery managers recommend continued application of Zero Nighttime Flow limitations and criteria, implemented since 2005, at the Snake River projects.

JUSTIFICATION: Zero nighttime flow operations at federal projects in the Lower Snake River have been the subject of much discussion since the dams were completed. Decades of discussion culminated in limiting Zero Nighttime Flow operations to periods after December 1 and through February 28 "when there are few, if any, actively migrating anadromous fish present in the Snake River" in Water Management Plan Seasonal Updates beginning in 2004. Fish managers defined "few, if any" in SOR 2005-22 and the criteria in this definition have guided and governed implementation since then. However, zero night time flow operations do not support normal ecological river functions and as such are not supported by all fish managers.

The 2020 Columbia River System Operations Biological Opinion (Page 65, Section 1.3.1.3.) and pending Water Management Plan do not include fish-based zero flow implementation criteria and extends the zero flow operation period by 45 days:

> *"Between October 15 and February 28, when power market conditions warrant and when river conditions make it feasible, power generation at Snake River projects may cease, and water stored, during nighttime hours, most commonly implemented between 2300 and 0500 hours when demand for power is lowest or other renewable resources are generating surplus power (or both). This operation will end no later than 2 hours before dawn between October 15 and November 30. During the operation between December 15 and February 28, daytime hours will no longer be excluded from this operation, and up to 3 hours of daytime cessation will be part of the proposed action."*

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Zero nighttime flow is a load-following operation, often referred to as "peaking", where water is stored during periods of low power demand and subsequently released when demand is high. Little definitive information on the impacts of peaking on anadromous fishes in the Lower Snake River exists and is largely limited to upstream migrating adults, with no analysis of the impacts on juveniles. Furthermore, it is difficult to predict the impacts of the new zero nighttime flow operation because of the flexibility afforded to the Action Agencies — it can occur every day or very seldom. No study completed to date indicates that zero flow operations benefit fish passage or protection measures.

Impacts on adults

Multiple species of anadromous fish migrate through the lower Snake River as adults during October, November, and December (Figure 1). Chinook salmon passing Lower Granite dam after August 17th are considered fall Chinook run type. Fall chinook adult run timing currently peaks in late-September and continues through late November. The 10-year average Lower Granite Dam daily passage abundance of fall Chinook on October 15th is 218 fish. Many of these adults move through the Lower Snake in ripe spawning condition, with spawning typically starting in early-October and extending into early-December. Migration of adult coho salmon through the Lower Snake River starts in mid-September, peaks in early-October, and continues through late-November. Similar to fall Chinook, coho have a minimal maturation

period between arrival to natal streams and spawning. Adult steelhead are present year-round, with peak passage at Lower Granite Dam occurring around the end of September. The 10-year average daily steelhead passage on October 15th is 1,681 fish.

Three separate studies have investigated the response of migrating adult fish to zero nighttime flow operations — McMaster et al 1977, Liscom et al. 1985, and Bjornn et al. 1998 — with variable results and limited direct applicability to the operation set to begin October 15th, 2020.

McMaster et al. 1977 used a small number of radio tags, magnetic tags, and count data to monitor Chinook salmon and steelhead movement patterns under controlled nighttime flows (10,000 or 20,000 cfs) or zero nighttime flow in 7 day blocks during July – November 1975 and on 2 day rotating blocks from July – September 1976. Radio tagged Chinook salmon had low conversion rates, which the authors attributed to handling and tagging effects. The authors did not attribute changes in steelhead behavior to the zero nighttime flow operations.

Following the results of McMaster et al. 1977, Bonneville Power Administration requested the ability to implement zero flow conditions for 9 hours at night (22:00 – 07:00) and for a continuous 35 hours on weekends from August – April (Liscom et al. 1985). Concern over this operation led NMFS and the state fishery agencies to again study adult passage under zero flow conditions by radio tagging 232 steelhead and 32 Chinook salmon and monitoring their migration rate between Lower Monumental and Little Goose Dams from July – September 1981. They used alternating 1 week blocks of the zero flow operations requested by BPA and "normal" conditions. This study found high variability in passage times under zero flow conditions potentially worsened by high water temperatures, which also reduced tagging rates. Travel times for steelhead and Chinook salmon were significantly higher between Lower Monumental and Little Goose Dams during zero flow treatment blocks.

As part of a large multi-part study on adult salmon and steelhead migration, Bjornn et al. (1998) employed spaghetti loop tags and radio transmitters to steelhead in two week blocks of zero versus minimum flows from September – mid November 1991-1993 where zero flow was implemented between 23:00 and 05:00. These authors found changes in steelhead travel time, but differences were not statistically significant and attributed the observed changes in passage to differences in temperature among treatment blocks. More specifically, slow travel times were documented at the beginning (early September) and end (late October) of the study period.

The combined results of these three studies suggest that the impacts of zero nighttime flow may be small for steelhead, but larger for Chinook. However, all three studies discuss temperature as a confounding factor and the difficulty of drawing conclusions from this type of blocked design. No study investigated coho, or tagged Chinook later than mid-September. It is, however, important to note that zero nighttime flow operations may directly impact steelhead passing the dams at night, which was estimated to be 5.4 – 8.7% of adult steelhead passing Lower Granite Dam during non-window count hours (20:00 – 04:00) (FPC 2015).

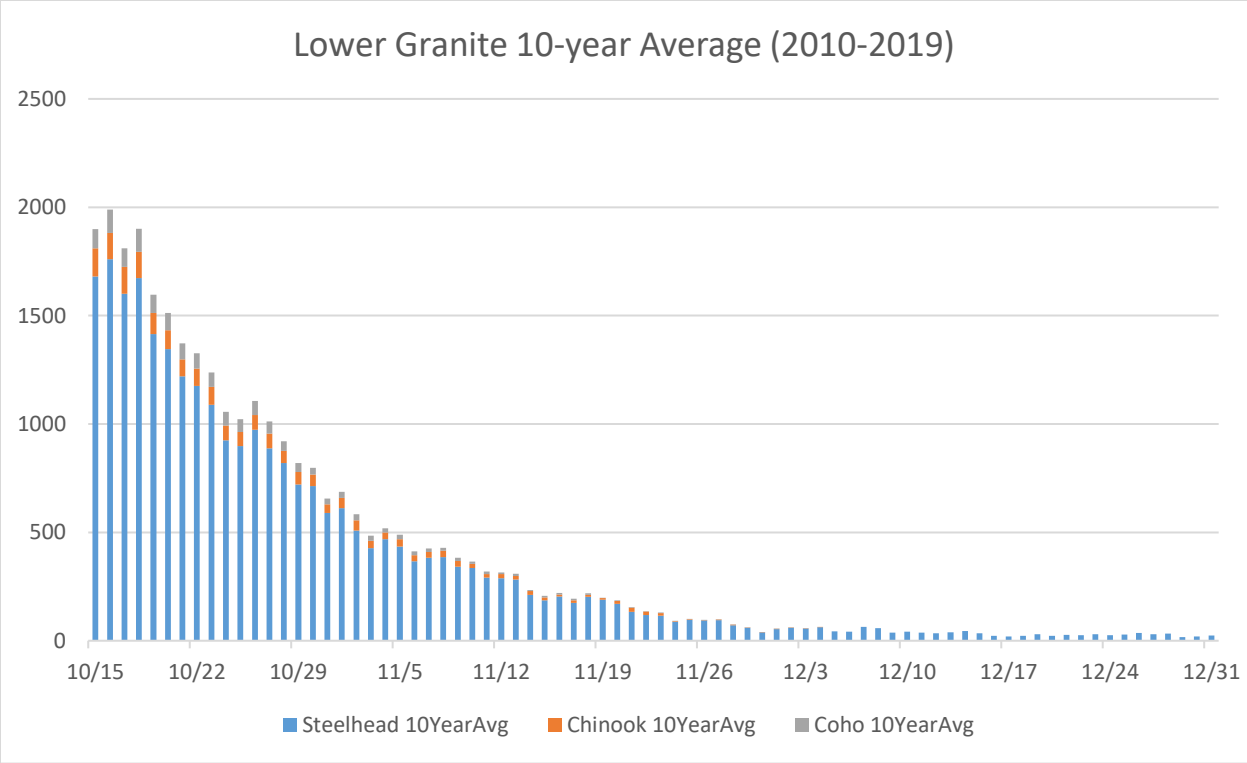

Figure 1. Daily adult passage at Lower Granite Dam (10-year average) for steelhead, fall Chinook, and coho. Data generated by U.S. Army Corps of Engineers, downloaded from DART (http://www.cbr.washington.edu/dart/query/adult_daily) on September 14, 2020.

Impacts on juveniles

Assessment of zero nighttime flow operations on juvenile fall Chinook behavior has not occurred and effects are unknown.

Juvenile migrants passing Lower Granite Dam October through December are primarily natural-origin fall Chinook salmon originating from Clearwater basin spawning aggregates (Figure 2). Index median passage timing of natural-origin juveniles tagged in the Clearwater River is October 25 (Figure 3). Juvenile fall Chinook emigration timing is diverse, with a majority passing May through July as sub-yearling smolts. Abundance gradually decreases through September as the juveniles that remain transition to a lower Snake River reservoir rearing yearling life-history, then increases after the beginning of October, with spikes of movement into lower Snake River critical habitats - likely associated with environmental cues. The Lower Granite Dam juvenile bypass system (JBS) is typically shutdown in late November, limiting data on juvenile movement (Connor et al 2011). Radio tag data generated by USGS (Tiffan et al 2012) shows juvenile fall Chinook passage continues after shutdown of the JBS. Radio tag data also shows passage is normally distributed between nighttime and daytime periods (i.e. juvenile fish do not stop migrating at night) (Figures 4 and 5).

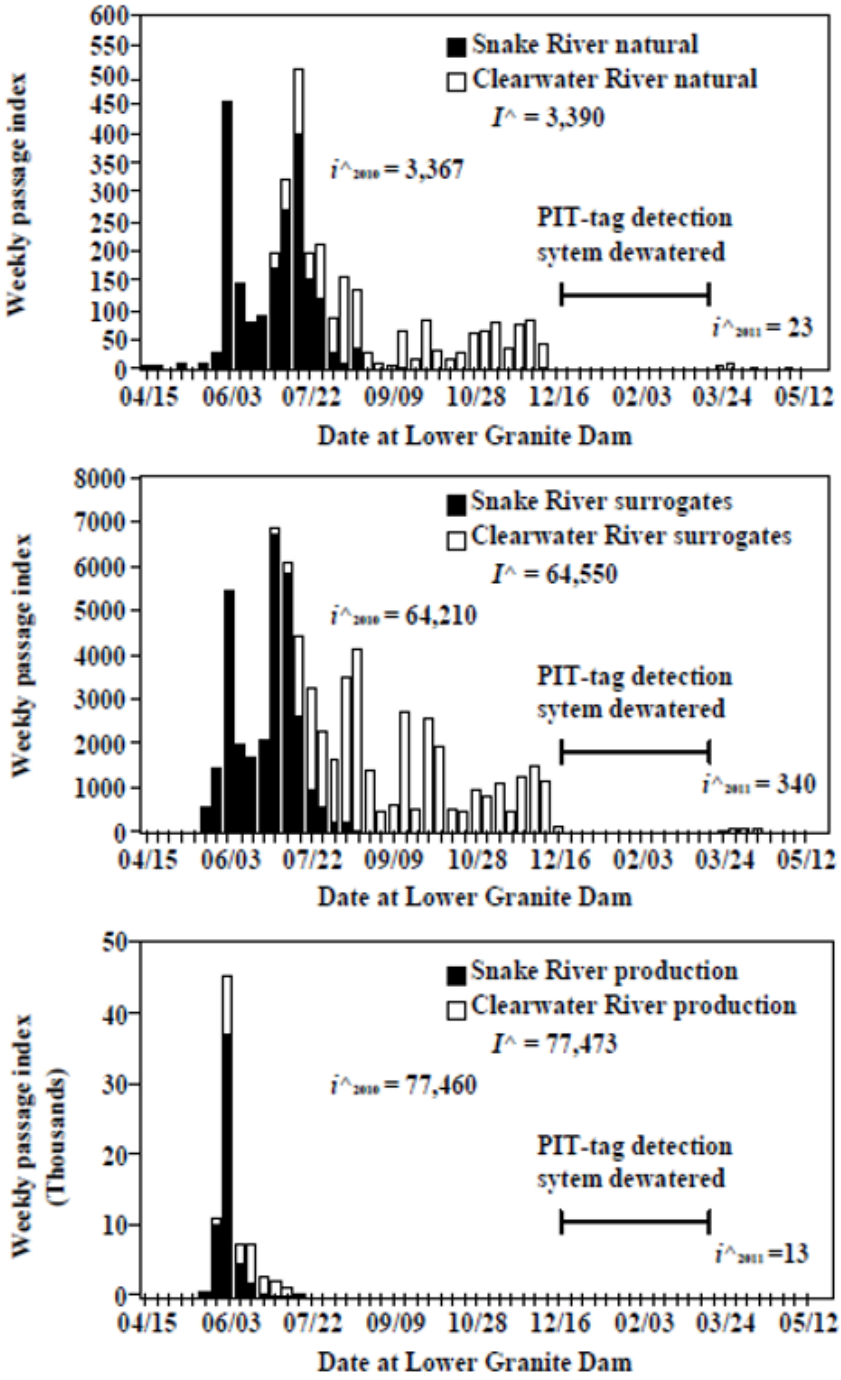

Figure 2 – Replicated Figure 2 from Connor et al (2011). Weekly passage indices at Lower Granite Dam during migration years 2010 and 2011 for Snake River and Clearwater river natural (top panel), surrogate (middle panel) and production (bottom panel) fall Chinook salmon juveniles based on fish that were PIT tagged and released in 2010. The weekly indices were summed across migration years 2010 and 2011(Iˆ) and within each migration year 2010 (iˆ2010) and 2011 (iˆ2011).

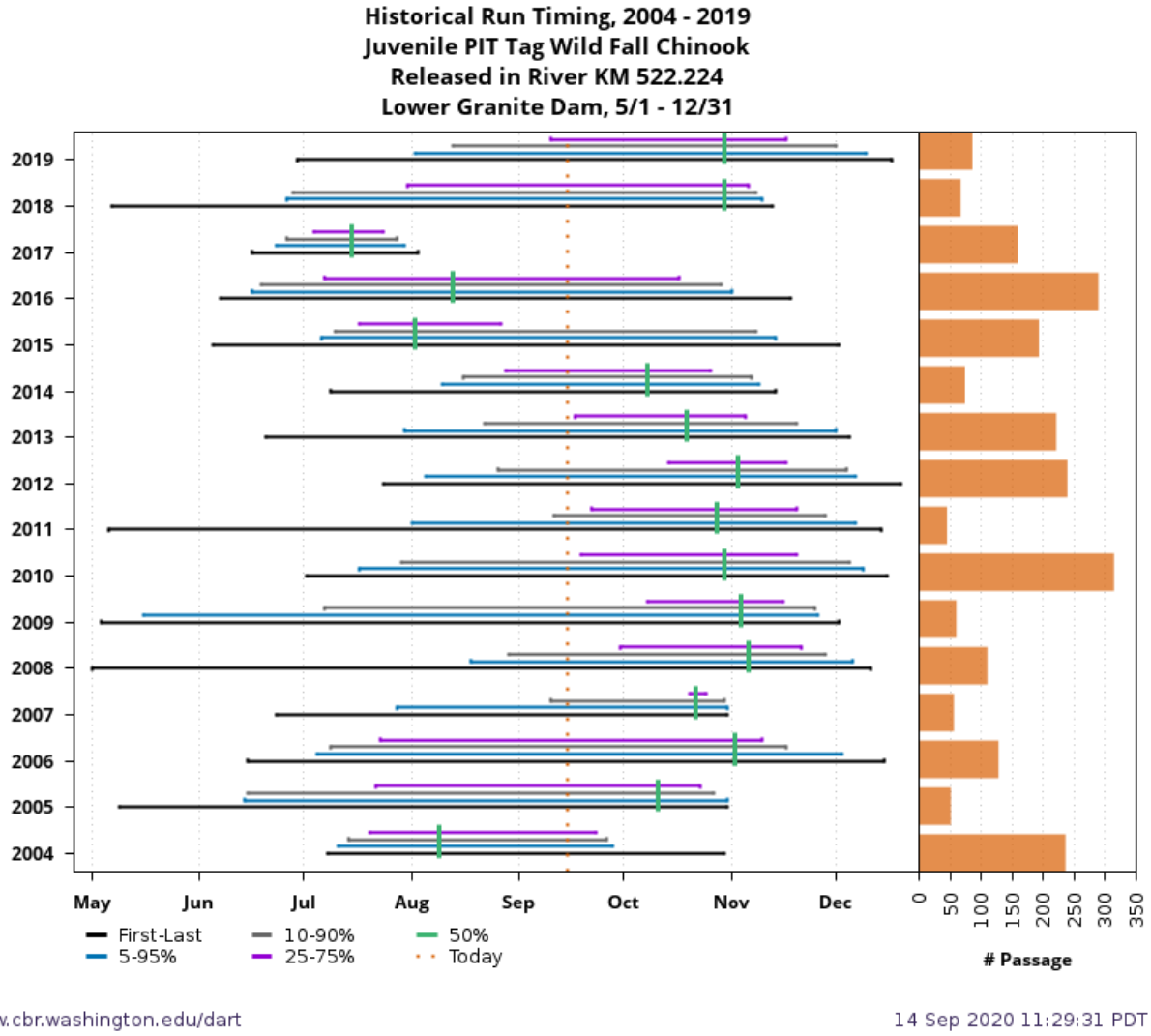

Figure 3. Passage timing of natural (wild) origin fall Chinook salmon from the Clearwater River spawning aggregate of the Snake River population. Data generated by Nez Perce Tribe, downloaded from DART (http://www.cbr.washington.edu/dart/query/smolt_hrt) on September 14, 2020.

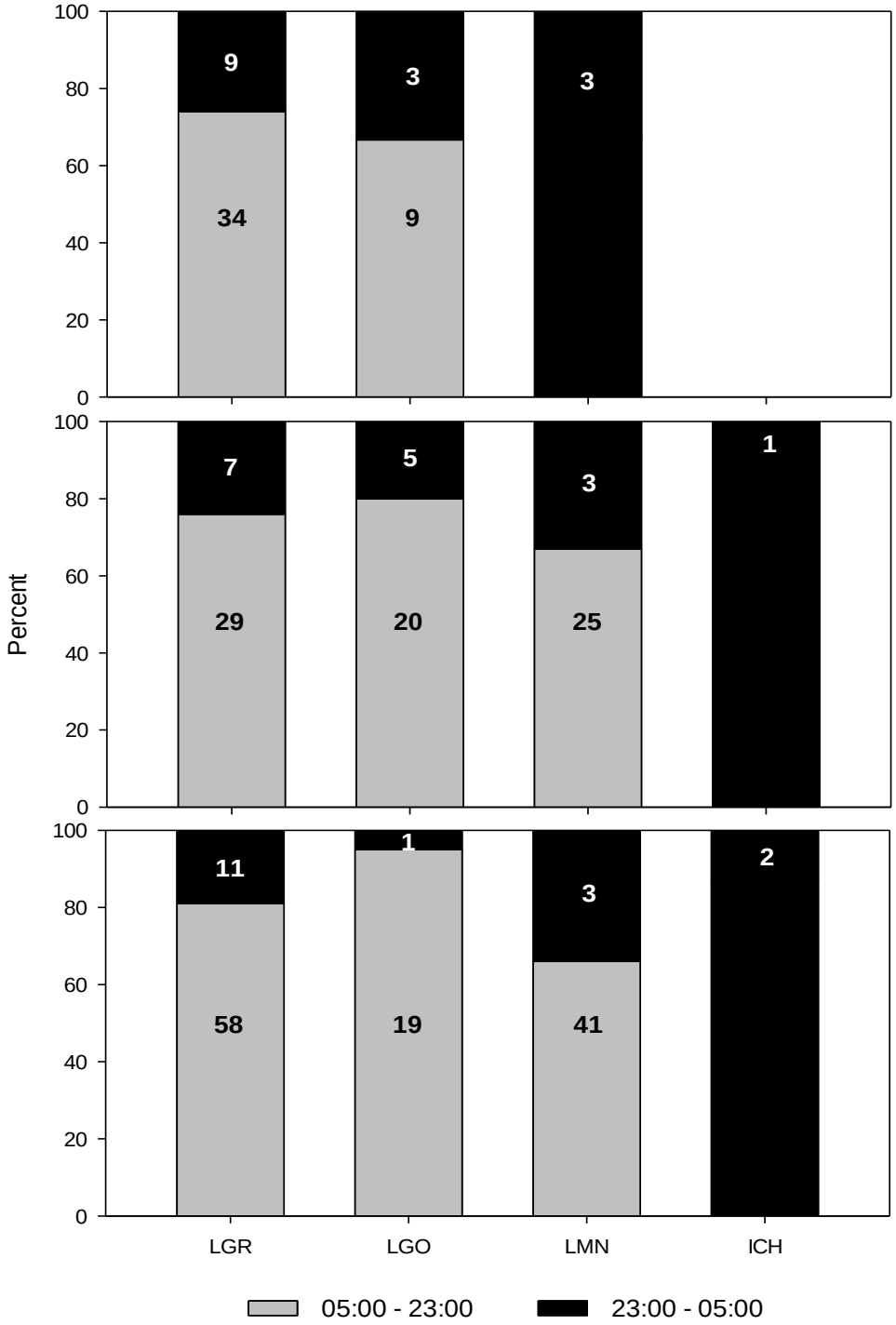

Figure 4. Percentage of radio-tagged subyearling fall Chinook salmon passing dams during periods of proposed zero-flow (black bars) and all other times (gray bars) from Nov 1 to March 19 during 2004-2005 (top panel), 2005-2006 (middle panel), and 2006-2007 (bottom panel). Numbers of fish detected are shown within each bar. Dams are abbreviated LGR (Lower Granite), LGO (Little Goose), LMN (Lower Monumental), and ICH (Ice Harbor). All fish were collected, tagged, and released in the forebay of Lower Granite Dam. Analysis and graphic provided by K. Tiffan – modification of Tiffan et al 2012.

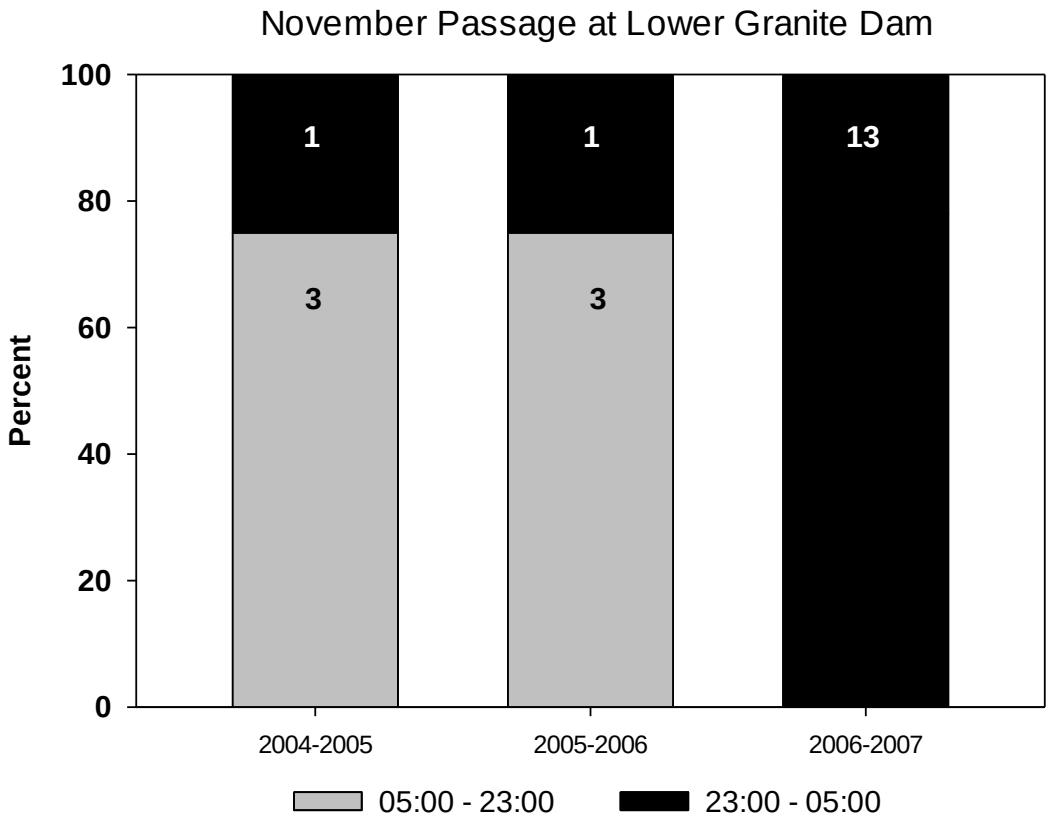

Figure 5. Percentage of radio-tagged subyearling fall Chinook salmon passing Lower Granite Dam during periods of proposed zero-flow (black bars) and all other times (gray bars) from Nov 1 to Nov 30 during 2004-2005, 2005-2006, and 2006-2007. Numbers of fish detected are shown within each bar. All fish were collected, tagged, and released in the forebay of Lower Granite Dam. Analysis and graphic provided by K. Tiffan – modification of Tiffan et al 2012.

System Operations Request 2005-22 defined "few" migrating adults; this SOR has guided operations through 2019. Over time, these criteria have been slightly modified to include:

1. The number of adults migrating per day is defined as the number of upstream counts minus the number of downstream counts, as reported on the Fish Passage Center's website (https://www.fpc.org/currentdaily/HistFishTwo_7day-ytd_Adults.htm).
2. A three-day moving average will be used to determine if the few migrating adult criterion has been met.
3. The criteria apply to both "Unclipped" and "total" categories of returning adult steelhead. "Unclipped" and "total" returns will be calculated separately. Only one of the categories is necessary to show that more than a few adults are migrating.
4. The run to date is defined as the cumulative number of adult steelhead in the "Unclipped" and "total" categories passing Lower Granite Dam since July[1] 1st of the return year.

[1] SOR 2005-22 based adult steelhead counts on a June 1st start date. July 1st is currently used for return year abundance quantification.

The 'few' migrating adult criteria triggers are defined on a sliding scale (Table 1). Juvenile fish-based criteria are not practical given the JBS is typically shutdown prior to December 1, precluding the ability to monitor juvenile fish abundance.

Table 1. Sliding scale adult steelhead abundance at Lower Granite Dam and associated criteria allowing zero flow operations to occur at Snake River project between December 1 and February 28.

Run to date > #	Run to date ≤ #	Few criteria < #
0	30,000	10
30,000	60,000	20
60,000	100,000	35
100,000	150,000	50
150,000	200,000	65
200,000	250,000	80
250,000		100

Water stored under zero river flow conditions may maximize power production from the Columbia River basin system, but zero river flow operations are not recommended at lower Snake River projects when juvenile and/or adult fish are actively migrating or dispersing into available critical habitat in the Snake River. The salmon managers recommend zero flow operations not be implemented prior to December 1st and that the longstanding 'few fish' criteria be used, after December 1, for initiating zero nighttime flow operations.

References

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Fish Passage Center. 2015. Update: Proportion of adult steelhead passing Lower Granite Dam during nighttime non-counting hours. Memo 48-15. March 23, 2015.

Liscom, K. L. Stuehrenberg, and F. Ossiander. 1985. Radio-tracking studies of adult Chinook salmon and steelhead to determine the effect of "zero" river flow during water storage at Little Goose Dam on the lower Snake River. https://www.webapps.nwfsc.noaa.gov/assets/26/7128_07022012_111137_Liscom.et.al.1985b.pdf

McMaster, K. M., R. G. White, R. R. Ringe, and T. C. Bjornn. 1977. Effects of reduced nighttime flows on upstream migration of adult Chinook salmon and steelhead trout in the lower Snake River.

https://cdm17254.contentdm.oclc.org/utils/getfile/collection/idahowater/id/496/filename/iwdl-197713.pdf

Tiffan et al. 2012. Downstream movement of fall Chinook salmon juveniles in the Lower Snake River reservoirs during winter and early spring. Transactions of the American Fisheries Society 141: 285-293.

To: Michael Tehan, RIOG Chair
From: Dave Johnson, NPT; Ed Bowles, ODFW; Michael Garrity, WDFW; Rob Lothrop, CRITFC
Cc: RIOG Representatives

Date: October 12, 2020

Re: Zero Flow Operations at Lower Snake River Dam

At the September 30th, 2020 Technical Management Team (TMT) meeting (meeting notes at http://pweb.crohms.org/tmt/sor/2020/), the Corps of Engineers decided not to implement a System Operations Request (SOR 2020-6 Attachment 1) that would retain abundance-based criteria to guide Zero Nighttime Flow Operations in the Snake River. The only TMT entities to object (without elevation) to the SOR were the Bonneville Power Administration, Corps of Engineers, and Bureau of Reclamation[1]. The Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Nez Perce Tribe, and Confederated Tribes of the Umatilla Indian Reservation strongly disagree with this decision and are elevating the issue for further consideration to the Regional Implementation Oversight Group (RIOG). Timely resolution is critical, because implementation of the operation in question is scheduled to commence as soon as October 15th. We request the Action Agencies postpone implementing this operation until resolution is achieved.

Background

- The recently issued Columbia River System Operation (CRSO) Record of Decision (ROD) and supporting Biological Opinions (BiOps) describe periods of daily stoppage of downstream flows (concurrent periods of zero generation and zero spill), at all four Snake River projects, between October 15 and February 28. This extends the zero flow operational window by at least 45 days from recent operations, which were guided by abundance-based criteria after December 1 (SOR 2005-22).
- The CRSO ROD and associated BiOps eliminate fish (adult steelhead) abundance-based criteria of "few, if any" fish established in 2005, do not establish performance standards and do not require specific monitoring for potential impacts.
- Discrepancies on the frequency and duration of zero flow conditions exist between the Final Environmental Impact Statement (FEIS) Preferred Alternative (PA), Biological Assessment (BA), BiOp, and ROD (Table 1)[2]. The BiOp and ROD limit implementation to 6 to 9 hours per day. The PA zero flow operation could result in stagnant river (lake) conditions over a 140-mile reach of the Snake River for the equivalent of 22% of the year.
- No analysis of Zero Flow Operation effect on fish was conducted in the FEIS, in spite of the need for such analysis being raised by multiple entities in Draft EIS comments (Attachment 2).

[1] NOAA-Fisheries and Montana Abstained; USFWS, Colville Tribe, and State of Idaho had No Objection; and Oregon, Washington, Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation, Spokane Tribe of Indians, and Warm Springs Tribe voiced Support of the SOR.

[2] Over 18 hours a day would have been possible at times under the PA.

Table 1. Timing and duration of Zero Flow Operations at Snake River dams as described in the Preferred Alternative (PA), CRS Biological Assessment (BA), 2020 CRS Biological Opinion (BiOp), and Record of Decision (ROD).

	PA	BA	BiOp	ROD
Oct. 15 – Nov. 30	All nighttime hours, ceasing 2 hours before dawn	All nighttime hours ending 2 hours before dawn. Estimated use 1 out of 3 to 5 days.	2300 – 0500, ending 2 hours before dawn. Estimated use 1 out of 3 to 5 days.	2300 – 0500, ending 2 hours before dawn.
Dec.1 – Dec. 14	All nighttime hours, plus 3 hours of daylight	All nighttime hours. Estimated use 1 out of 3 to 5 days.	2300 – 0500. Estimated use 1 out of 3 to 5 days.	2300 – 0500
Dec. 15 – Feb 28	All nighttime hours, plus 3 hours of daylight	All nighttime hours, plus 3 hours of daylight. Estimated use 1 out of 3 to 5 days.	2300 – 0500 plus 3 hours of daylight. Estimated use 1 out of 3 to 5 days.	2300 – 0500 and up to 3 hours of daytime
Potential Implementation per project	1,967 hours; equivalent of 82 days or 22% of the year.	1,925 hours; equivalent of 80 days or 22% of the year.	273 hours; equivalent of 11 days or 3% of the year (assumes 1 out 4 day average use).	1,092 hours; equivalent of 45 days or 12% of the year.

- The 2020 Biological Opinion does not analyze the effect (take) associated with the Zero Flow Operation on adult steelhead or Snake River fall Chinook. Without analysis, the BiOp conclusion that "there could be a small (hours or days) effect on adult migration timing…[or] would not expect these delays to measurably impact adult survival rates" on Snake River fall Chinook (2020 BiOp page 611) is not justified. This Zero Flow Operation is not addressed in the 2020 CRS Biological Opinion Terms and Conditions or Conservation Recommendations (Attachment 2).
- The 2020 Biological Opinion does not analyze the effect (take) of hydro-system operations after August 31st, including Zero Flow Operations, on juvenile fall Chinook (Attachment 2).
- The ROD and BiOp inaccurately describe the operation would be implemented "when adult fish are typically not passing….and very few adult fish are still migrating in the river" (ROD page 60) and "when fewer than 10 percent of the adult SR fall Chinook migrate through the Snake River" (2020 BiOp page 611) (Attachment 2). These inaccuracies are addressed in the SOR.
- The SOR provides a description of 10-year average adult fish abundance, by date, passing Lower Granite Dam. During October and November, fall Chinook, coho, and steelhead are actively migrating upstream (Attachment 1). Subsequent analysis by the Nez Perce Tribe shows adult fish migrate through the fish ladders at all hours of the day (Figures 1 - 3).

- The SOR provides a description of juvenile fish abundance. Juvenile fish (ESA listed natural origin fall Chinook) are moving past Lower Granite Dam through the duration of the proposed Zero Flow Operation. The average index median passage timing of natural origin production from the Clearwater River spawning aggregate (which on average has contained 43% the total Snake River population redds over the past 5 years) at Lower Granite Dam is after October 15th (Attachment 1).
- Historic implementation of Zero Flow Operations has been highly variable, with reasons for not implementing being related to power market demand, river condition feasibility, and project operation and maintenance limitations was generated by Bonneville Power Administration for the TMT meeting (http://pweb.crohms.org/tmt/agendas/2020/0930_Zero_Gen_Historical_Use.pdf; Attachment 3). Subsequent analysis by Oregon Department of Fish and Wildlife shows implementation of Zero Nighttime flows could increase significantly from recent levels and approach similar occurrence frequency to pre-ESA listing operations.
- Implementation of the extended Zero Nighttime Flow Operation fails to include premises of "no worse for fish" or "error in favor of listed species."
- Scope of SOR 2020-6 was specific to extended duration (earlier initiation) of Zero Nighttime Flow Operations. State and Tribal fish managers remain concerned about Zero Nighttime Flow Operations and ladder shutdown periods occurring in December through February.

Requested RIOG Action

Action Agencies commit to following SOR 2020-6 that would retain abundance-based criteria to guide Zero Nighttime Flow Operations in the Snake River.

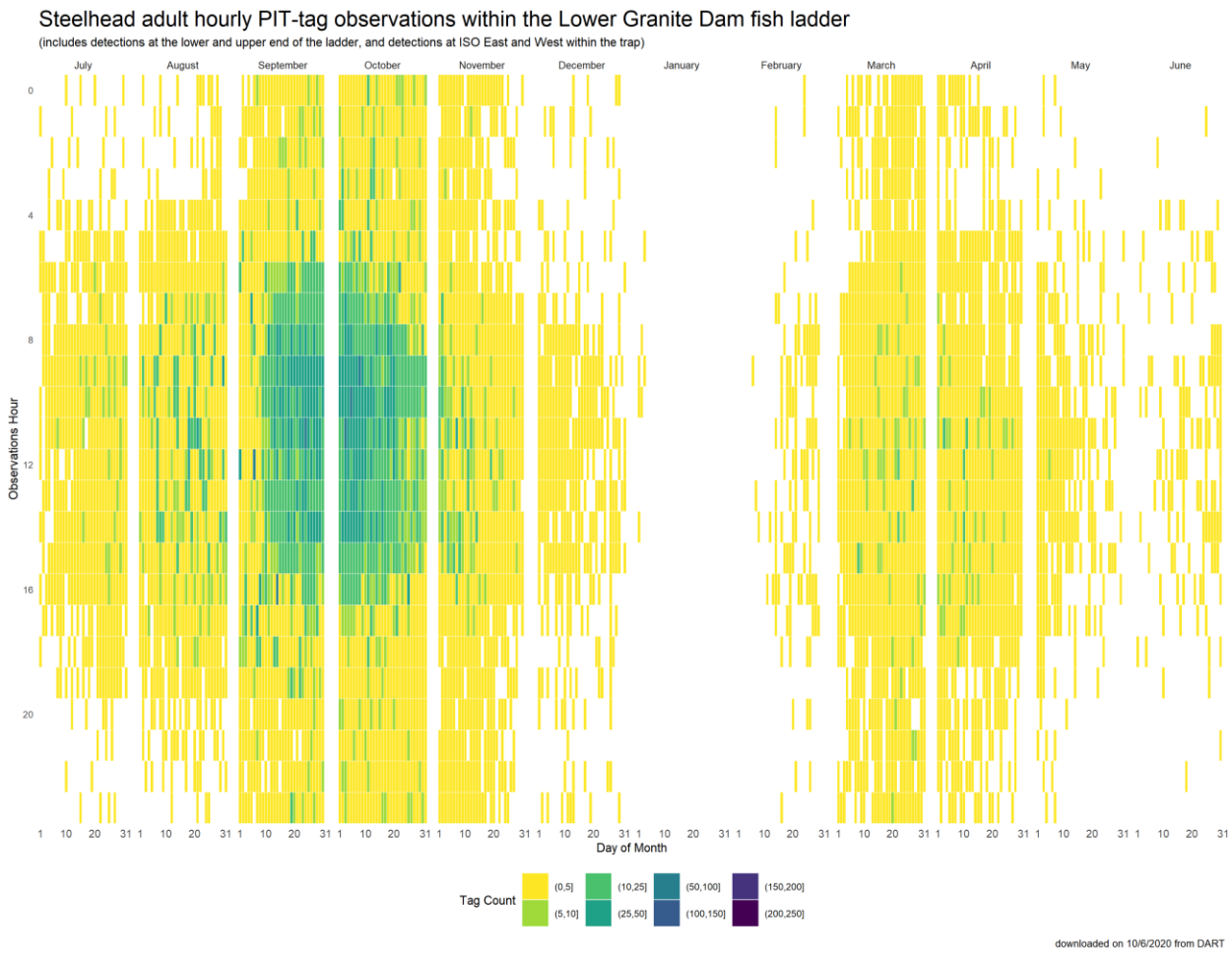

Figure 1. Hourly PIT-tag observations of adult steelhead within the Lower Granite Dam fish ladder, 2010-2020. Data generated by Pacific States Marine Fisheries Commission, downloaded from DART (http://www.cbr.washington.edu/dart/cs/data/nezperce/nptspawn_GRA_2020_3.csv) on October 6, 2020.

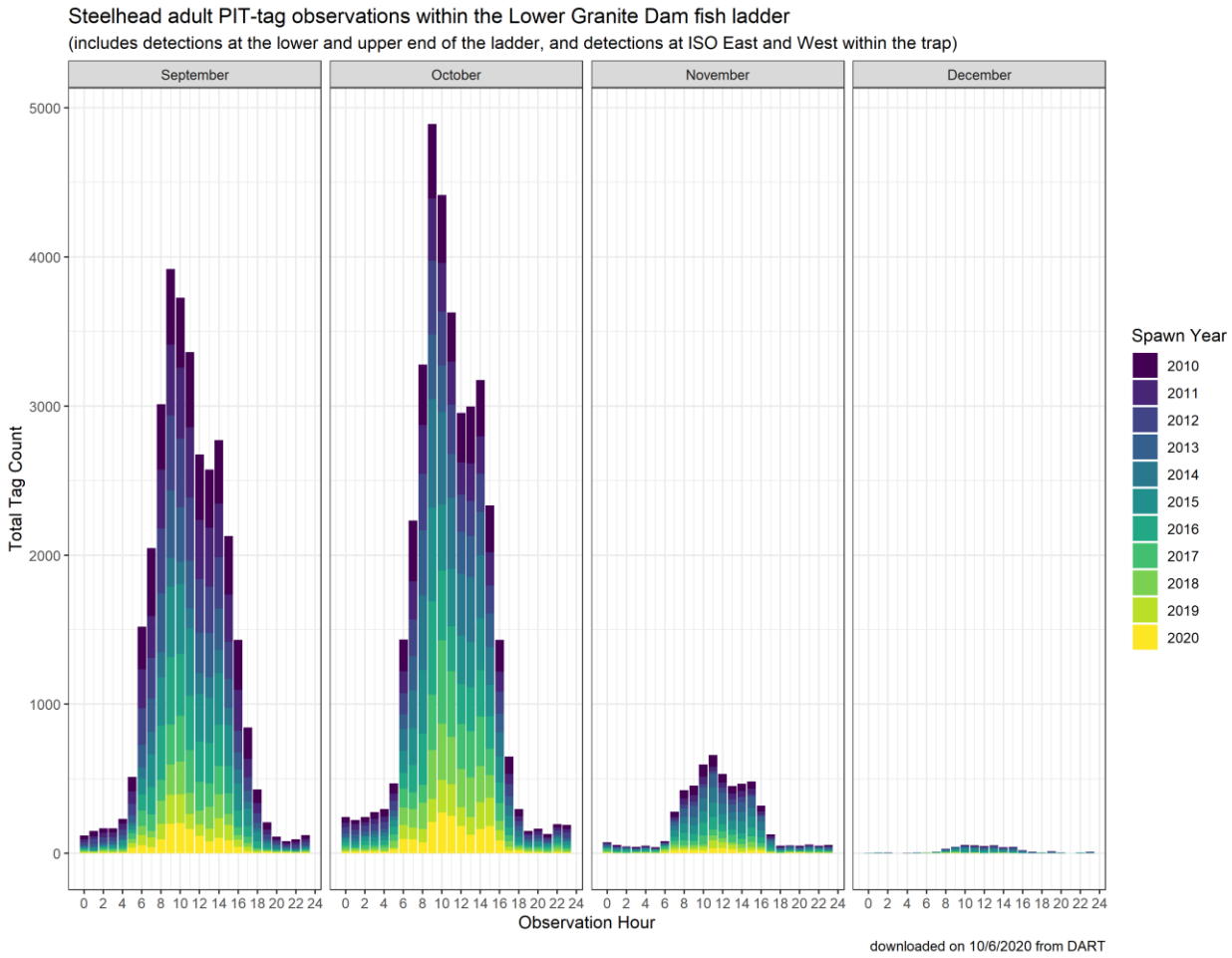

Figure 2. Hourly PIT-tag observations per month of adult steelhead within the Lower Granite Dam fish ladder, during September, October, November, and December 2010-2020. Data generated by Pacific States Marine Fisheries Commission, downloaded from DART (http://www.cbr.washington.edu/dart/cs/data/nezperce/nptspawn_GRA_2020_3.csv) on October 6, 2020

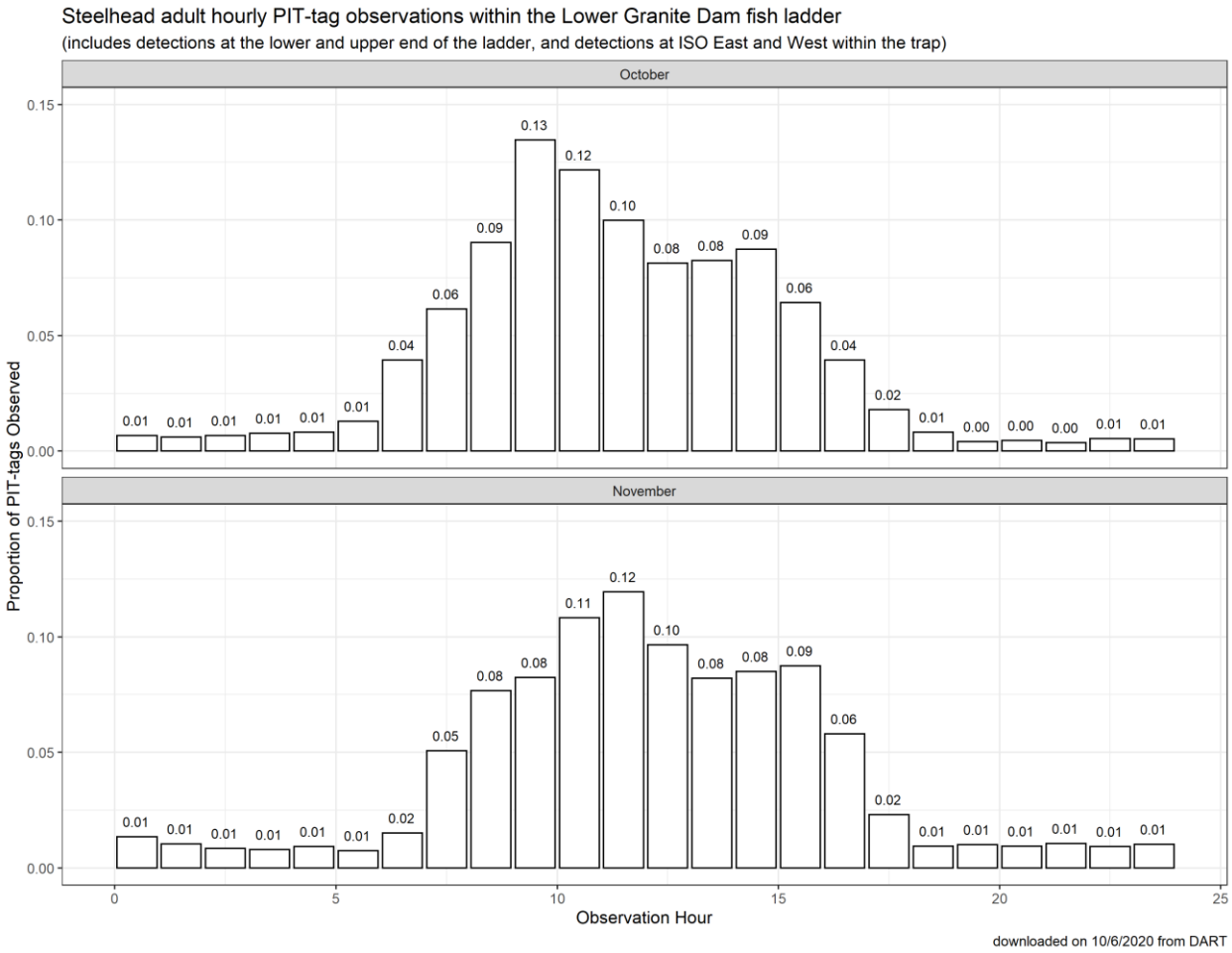

Figure 3. Proportion of PIT-tagged adult steelhead detected hourly within the Lower Granite Dam fish ladder in October and November 2010-2020. Data generated by Pacific States Marine Fisheries Commission, downloaded from DART (http://www.cbr.washington.edu/dart/cs/data/nezperce/nptspawn_GRA_2020_3.csv) on October 6, 2020.

Attachment 1

SYSTEM OPERATIONAL REQUEST: #2020-6

WALLA WALLA DISTRICT

The following State, Federal, and Tribal Salmon Managers have participated in the preparation and support this SOR: Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Nez Perce Tribe, Yakama Nation, Warm Springs Tribe, Spokane Tribe of Indians, and the Columbia River Inter-Tribal Fish Commission.

TO:	Brig. Gen. Pete Helmlinger	COE-NWD-ZA Commander
	Lt. Col. Rick Childers	COE-NWW Commander
	Jim Fredericks	COE-NWD-PDD Chief
	Steven Barton	COE-NWD-PDW Chief
	Tim Dykstra	COE-NWD-PDD
	Julie Ammann	COE-NWD-PDW-R
	Doug Baus	COE-NWD-PDW-R
	Aaron Marshall	COE-NWD-PDW-R
	Lisa Wright	COE-NWD-PDW-R
	John Roberts	COE-NWW-EC-H
	Ann Setter	COE-NWW-OD-T
	Lorri Gray	USBR-PN Regional Director
	John Roache	USBR-PN-6208
	Joel Fenolio	USBR-PN-6204
	John Hairston	Acting BPA Administrator
	Kieran Connolly	BPA-PG-5
	Scott Armentrout	BPA-E-4
	Jason Sweet	BPA-PGB-5
	Eve James	BPA-PGBO-5
	Tony Norris	BPA-PGPO-5
	Scott Bettin	BPA-EWP-4
	Paul Cloutier	COE-NWD Tribal Liaison
	Dean Holecek	COE-NWW Tribal Liaison

FROM: Dave Swank, FPAC Chair

DATE: September 22, 2020

SUBJECT: Snake River Zero Nighttime Flow

SPECIFICATIONS: The fishery managers recommend continued application of Zero Nighttime Flow limitations and criteria, implemented since 2005, at the Snake River projects.

JUSTIFICATION: Zero nighttime flow operations at federal projects in the Lower Snake River have been the subject of much discussion since the dams were completed. Decades of discussion culminated in limiting Zero Nighttime Flow operations to periods after December 1 and through February 28 "when there are few, if any, actively migrating anadromous fish present in the Snake River" in Water Management Plan Seasonal Updates beginning in 2004. Fish managers defined "few, if any" in SOR 2005-22 and the criteria in this definition have guided and governed implementation since then. However, zero nighttime flow operations do not support normal ecological river functions and as such are not supported by all fish managers.

The 2020 Columbia River System Operations Biological Opinion (Page 65, Section 1.3.1.3.) and pending Water Management Plan do not include fish-based zero flow implementation criteria and extends the zero flow operation period by 45 days:

> *"Between October 15 and February 28, when power market conditions warrant and when river conditions make it feasible, power generation at Snake River projects may cease, and water stored, during nighttime hours, most commonly implemented between 2300 and 0500 hours when demand for power is lowest or other renewable resources are generating surplus power (or both). This operation will end no later than 2 hours before dawn between October 15 and November 30. During the operation between December 15 and February 28, daytime hours will no longer be excluded from this operation, and up to 3 hours of daytime cessation will be part of the proposed action."*

Dropping implementation criteria and implementing zero flow operations earlier would allow river flows in the Lower Snake River to be shutoff for up to 25% (6 hours) of each day (37.5% or 9 hours after December 15) for 4.5 months, even during periods of known significant adult and juvenile passage.

Zero nighttime flow is a load-following operation, often referred to as "peaking", where water is stored during periods of low power demand and subsequently released when demand is high. Little definitive information on the impacts of peaking on anadromous fishes in the Lower Snake River exists and is largely limited to upstream migrating adults, with no analysis of the impacts on juveniles. Furthermore, it is difficult to predict the impacts of the new zero nighttime flow operation because of the flexibility afforded to the Action Agencies — it can occur every day or very seldom. No study completed to date indicates that zero flow operations benefit fish passage or protection measures.

Impacts on adults

Multiple species of anadromous fish migrate through the lower Snake River as adults during October, November, and December (Figure 1). Chinook salmon passing Lower Granite dam after August 17th are considered fall Chinook run type. Fall chinook adult run timing currently peaks in late-September and continues through late November. The 10-year average Lower Granite Dam daily passage abundance of fall Chinook on October 15th is 218 fish. Many of these adults move through the Lower Snake in ripe spawning condition, with spawning typically starting in early-October and extending into early-December. Migration of adult coho salmon through the Lower Snake River starts in mid-September, peaks in early-October, and continues through late-November. Similar to fall Chinook, coho have a minimal maturation period between arrival to natal streams and spawning. Adult steelhead are present year-round, with peak passage at Lower Granite Dam occurring around the end of September. The 10-year average daily steelhead passage on October 15th is 1,681 fish.

Three separate studies have investigated the response of migrating adult fish to zero nighttime flow operations — McMaster et al 1977, Liscom et al. 1985, and Bjornn et al. 1998 — with variable results and limited direct applicability to the operation set to begin October 15th, 2020.

McMaster et al. 1977 used a small number of radio tags, magnetic tags, and count data to monitor Chinook salmon and steelhead movement patterns under controlled nighttime flows (10,000 or 20,000 cfs) or zero nighttime flow in 7 day blocks during July – November 1975 and on 2 day rotating blocks from July – September 1976. Radio tagged Chinook salmon had low conversion rates, which the authors attributed to handling and tagging effects. The authors did not attribute changes in steelhead behavior to the zero nighttime flow operations.

Following the results of McMaster et al. 1977, Bonneville Power Administration requested the ability to implement zero flow conditions for 9 hours at night (22:00 – 07:00) and for a continuous 35 hours on weekends from August – April (Liscom et al. 1985). Concern over this operation led NMFS and the state fishery agencies to again study adult passage under zero flow conditions by radio tagging 232 steelhead and 32 Chinook salmon and monitoring their migration rate between Lower Monumental and Little Goose Dams from July – September 1981. They used alternating 1 week blocks of the zero flow operations requested by BPA and "normal" conditions. This study found high variability in passage times under zero flow conditions potentially worsened by high water temperatures, which also reduced tagging rates. Travel times for steelhead and Chinook salmon were significantly higher between Lower Monumental and Little Goose Dams during zero flow treatment blocks.

As part of a large multi-part study on adult salmon and steelhead migration, Bjornn et al. (1998) employed spaghetti loop tags and radio transmitters to steelhead in two week blocks of zero versus minimum flows from September – mid November 1991-1993 where zero flow was implemented between 23:00 and 05:00. These authors found changes in steelhead travel time, but differences were not statistically significant and attributed the observed changes in passage to differences in temperature among treatment blocks. More specifically, slow travel times were documented at the beginning (early September) and end (late October) of the study period.

The combined results of these three studies suggest that the impacts of zero nighttime flow may be small for steelhead, but larger for Chinook. However, all three studies discuss temperature as a confounding factor and the difficulty of drawing conclusions from this type of blocked design. No study investigated coho, or tagged Chinook later than mid-September. It is, however, important to note that zero nighttime flow operations may directly impact steelhead passing the dams at night, which was estimated to be 5.4 – 8.7% of adult steelhead passing Lower Granite Dam during non-window count hours (20:00 – 04:00) (FPC 2015).

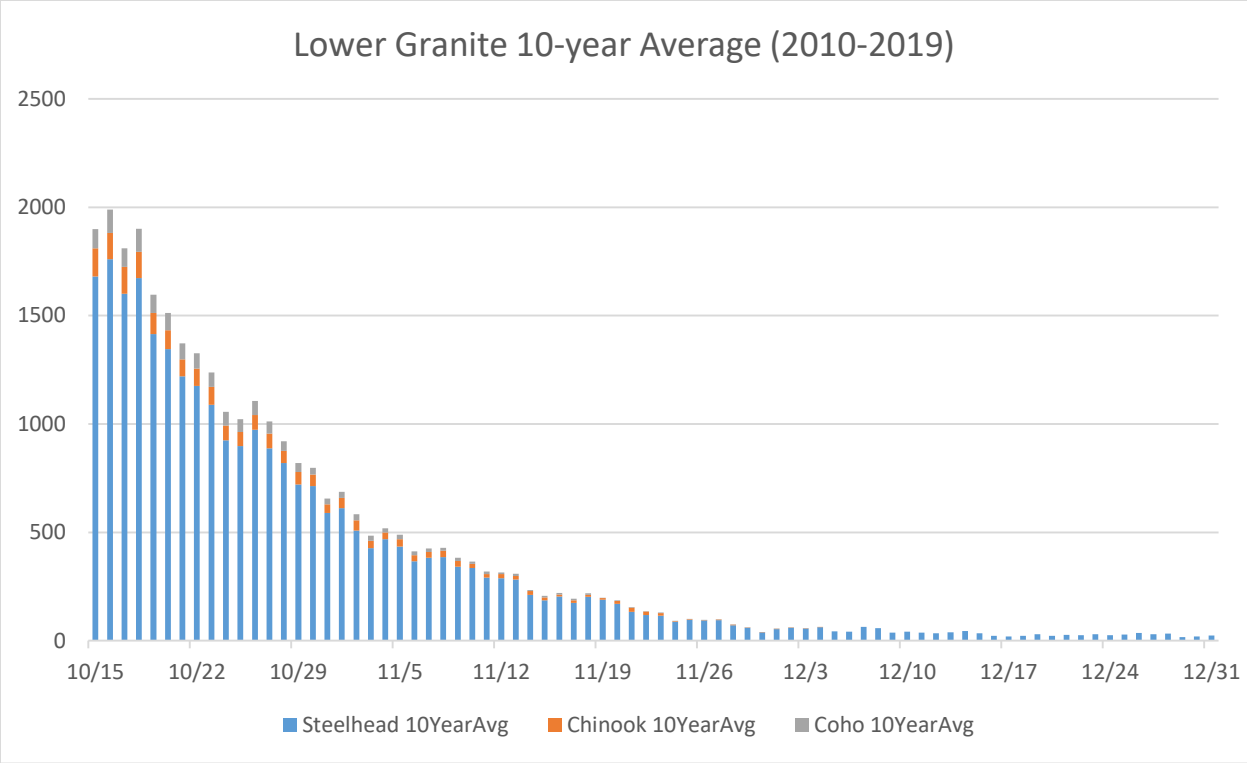

Figure 1. Daily adult passage at Lower Granite Dam (10-year average) for steelhead, fall Chinook, and coho. Data generated by U.S. Army Corps of Engineers, downloaded from DART (http://www.cbr.washington.edu/dart/query/adult_daily) on September 14, 2020.

Impacts on juveniles

Assessment of zero nighttime flow operations on juvenile fall Chinook behavior has not occurred and effects are unknown.

Juvenile migrants passing Lower Granite Dam October through December are primarily natural-origin fall Chinook salmon originating from Clearwater basin spawning aggregates (Figure 2). Index median passage timing of natural-origin juveniles tagged in the Clearwater River is October 25 (Figure 3). Juvenile fall Chinook emigration timing is diverse, with a majority passing May through July as sub-yearling smolts. Abundance gradually decreases through September as the juveniles that remain transition to a lower Snake River reservoir rearing yearling life-history, then increases after the beginning of October, with spikes of movement into lower Snake River critical habitats - likely associated with environmental cues. The Lower Granite Dam juvenile bypass system (JBS) is typically shutdown in late November, limiting data on juvenile movement (Connor et al 2011). Radio tag data generated by USGS (Tiffan et al 2012) shows juvenile fall Chinook passage continues after shutdown of the JBS. Radio tag data also shows passage is normally distributed between nighttime and daytime periods (i.e. juvenile fish do not stop migrating at night) (Figures 4 and 5).

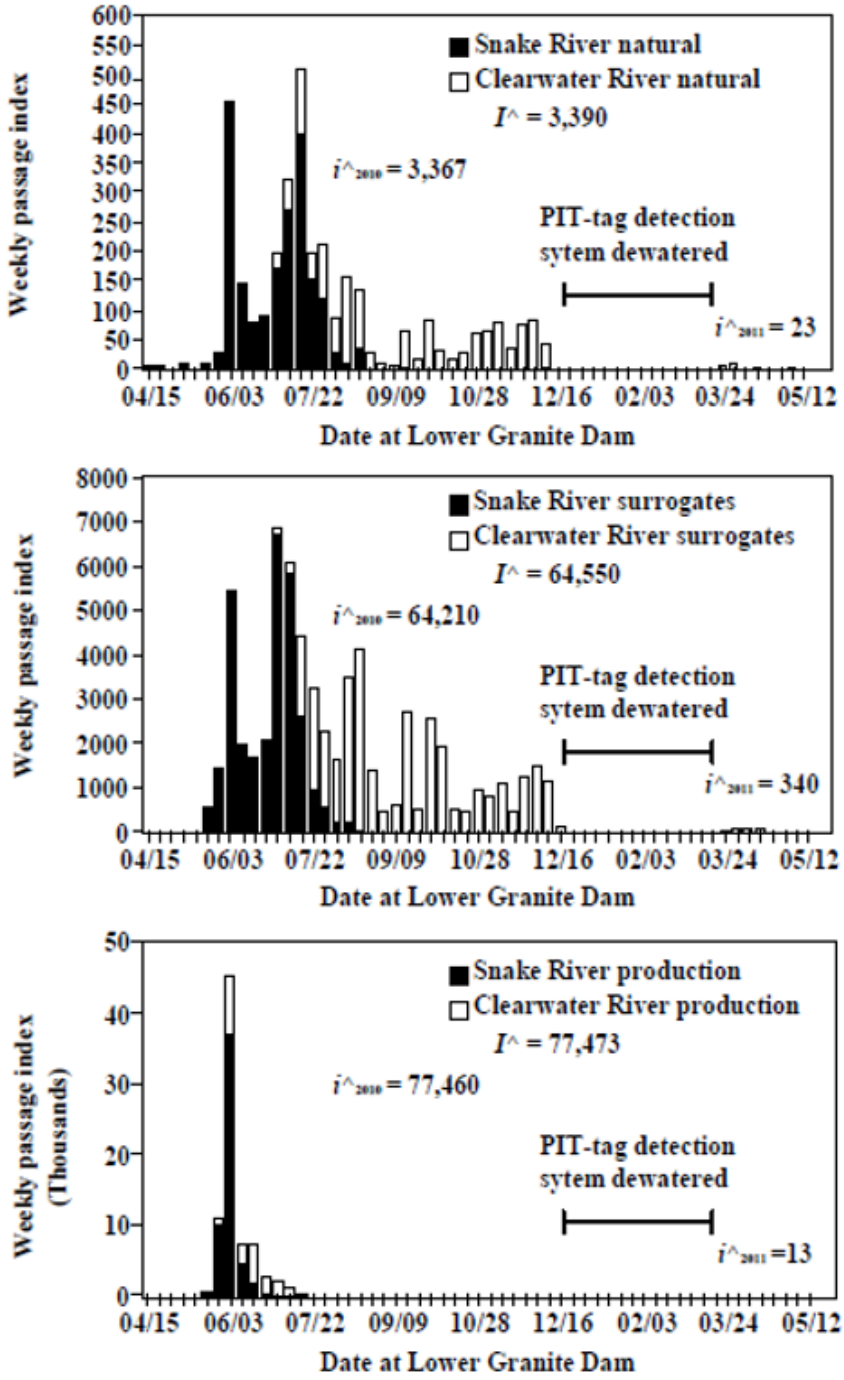

Figure 2 – Replicated Figure 2 from Connor et al (2011). Weekly passage indices at Lower Granite Dam during migration years 2010 and 2011 for Snake River and Clearwater river natural (top panel), surrogate (middle panel) and production (bottom panel) fall Chinook salmon juveniles based on fish that were PIT tagged and released in 2010. The weekly indices were summed across migration years 2010 and 2011(Iˆ) and within each migration year 2010 (iˆ2010) and 2011 (iˆ2011).

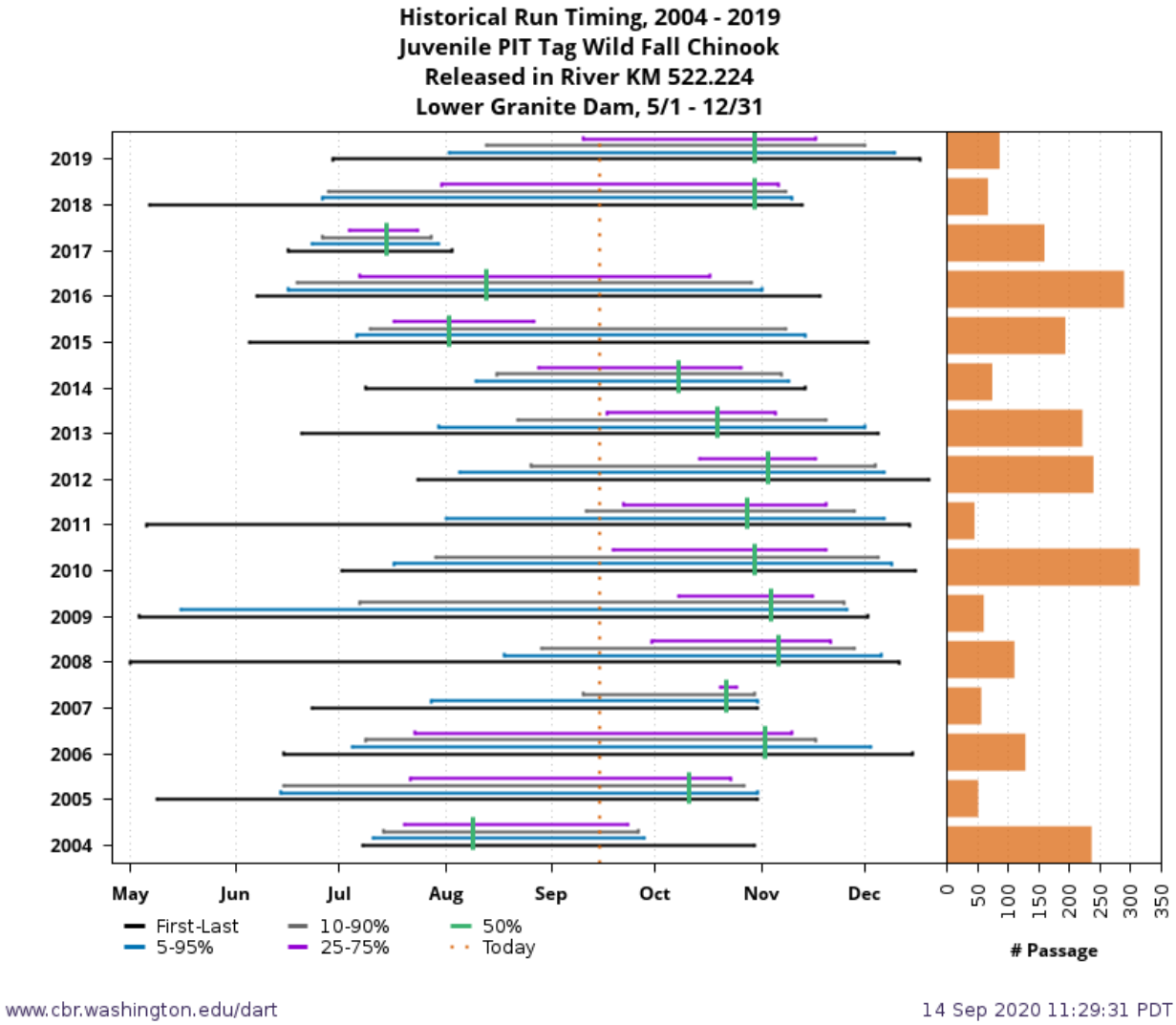

Figure 3. Passage timing of natural (wild) origin fall Chinook salmon from the Clearwater River spawning aggregate of the Snake River population. Data generated by Nez Perce Tribe, downloaded from DART (http://www.cbr.washington.edu/dart/query/smolt_hrt) on September 14, 2020.

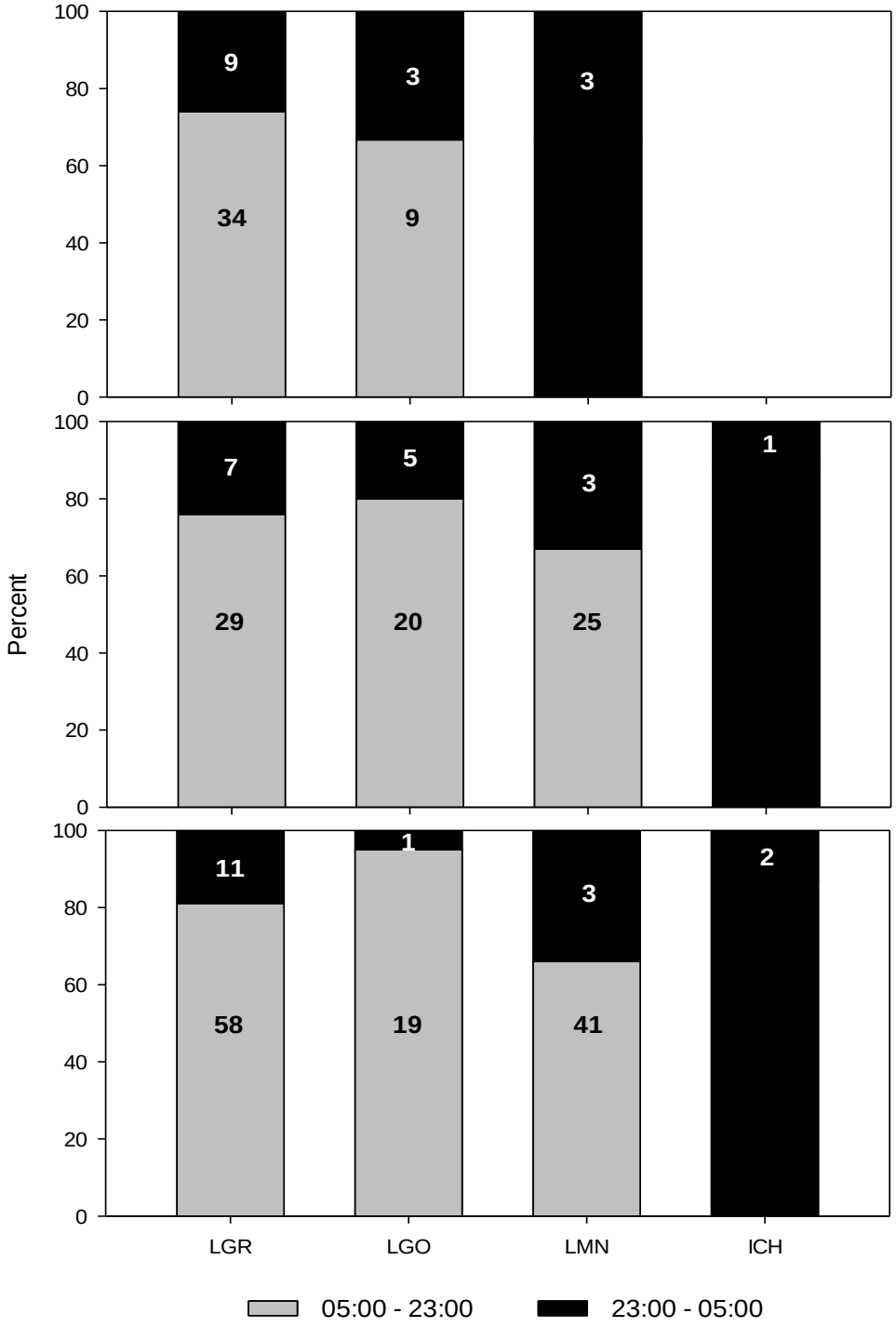

Figure 4. Percentage of radio-tagged subyearling fall Chinook salmon passing dams during periods of proposed zero-flow (black bars) and all other times (gray bars) from Nov 1 to March 19 during 2004-2005 (top panel), 2005-2006 (middle panel), and 2006-2007 (bottom panel). Numbers of fish detected are shown within each bar. Dams are abbreviated LGR (Lower Granite), LGO (Little Goose), LMN (Lower Monumental), and ICH (Ice Harbor). All fish were collected, tagged, and released in the forebay of Lower Granite Dam. Analysis and graphic provided by K. Tiffan – modification of Tiffan et al 2012.

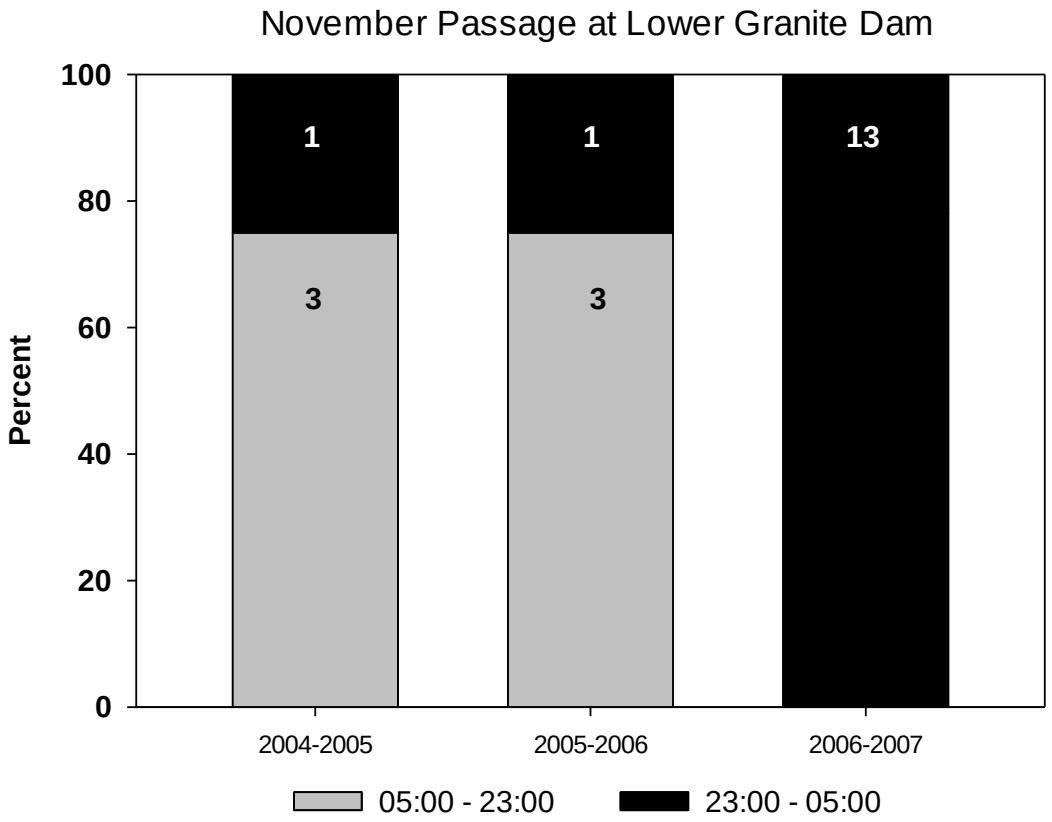

Figure 5. Percentage of radio-tagged subyearling fall Chinook salmon passing Lower Granite Dam during periods of proposed zero-flow (black bars) and all other times (gray bars) from Nov 1 to Nov 30 during 2004-2005, 2005-2006, and 2006-2007. Numbers of fish detected are shown within each bar. All fish were collected, tagged, and released in the forebay of Lower Granite Dam. Analysis and graphic provided by K. Tiffan – modification of Tiffan et al 2012.

System Operations Request 2005-22 defined "few" migrating adults; this SOR was has guided operations through 2019. Over time, these criteria have been slightly modified to include:

1. The number of adults migrating per day is defined as the number of upstream counts minus the number of downstream counts, as reported on the Fish Passage Center's website (https://www.fpc.org/currentdaily/HistFishTwo_7day-ytd_Adults.htm).
2. A three-day moving average will be used to determine if the few migrating adult criterion has been met.
3. The criteria apply to both "Unclipped" and "total" categories of returning adult steelhead. "Unclipped" and "total" returns will be calculated separately. Only one of the categories is necessary to show that more than a few adults are migrating.
4. The run to date is defined as the cumulative number of adult steelhead in the "Unclipped" and "total" categories passing Lower Granite Dam since July[3] 1st of the return year.

[3] SOR 2005-22 based adult steelhead counts on a June 1st start date. July 1st is currently used for return year abundance quantification.

The 'few' migrating adult criteria triggers are defined on a sliding scale (Table 1). Juvenile fish-based criteria are not practical given the JBS is typically shutdown prior to December 1, precluding the ability to monitor juvenile fish abundance.

Table 1. Sliding scale adult steelhead abundance at Lower Granite Dam and associated criteria allowing zero flow operations to occur at Snake River project between December 1 and February 28.

Run to date > #	Run to date ≤ #	Few criteria < #
0	30,000	10
30,000	60,000	20
60,000	100,000	35
100,000	150,000	50
150,000	200,000	65
200,000	250,000	80
250,000		100

Water stored under zero river flow conditions may maximize power production from the Columbia River basin system, but zero river flow operations are not recommended at lower Snake River projects when juvenile and/or adult fish are actively migrating or dispersing into available critical habitat in the Snake River. The salmon managers recommend zero flow operations not be implemented prior to December 1st and that the longstanding 'few fish' criteria be used, after December 1, for initiating zero nighttime flow operations.

References

Bjornn, T.C., P. J. Keniry, K. R. Tolotti, J. P. Hunt, R. R. Ringe. 1998. Effects of zero versus normal flow at night on passage of steelhead in summer and fall. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.715.1772&rep=rep1&type=pdf

Connor, W.P., B.D. Arnsberg, S.G. Smith, D.M. Marsh, W.D. Muir. 2011. Post release performance of natural and hatchery subyearling fall Chinook salmon in the Snake and Clearwater rivers. BPA annual reports 1983350003, 199102900, and 199801004.

Fish Passage Center. 2015. Update: Proportion of adult steelhead passing Lower Granite Dam during nighttime non-counting hours. Memo 48-15. March 23, 2015.

Liscom, K. L. Stuehrenberg, and F. Ossiander. 1985. Radio-tracking studies of adult Chinook salmon and steelhead to determine the effect of "zero" river flow during water storage at Little Goose Dam on the lower Snake River. https://www.webapps.nwfsc.noaa.gov/assets/26/7128_07022012_111137_Liscom.et.al.1985b.pdf

McMaster, K. M., R. G. White, R. R. Ringe, and T. C. Bjornn. 1977. Effects of reduced nighttime flows on upstream migration of adult Chinook salmon and steelhead trout in the lower Snake River. https://cdm17254.contentdm.oclc.org/utils/getfile/collection/idahowater/id/496/filename/iwdl-197713.pdf

Tiffan et al. 2012. Downstream movement of fall Chinook salmon juveniles in the Lower Snake River reservoirs during winter and early spring. Transactions of the American Fisheries Society 141: 285-293.

Attachment 2

EIS, PA, BA, BiOp, and ROD content relative to zero Nighttime flow operation (italicized text), with supplemental annotations (normal font)

Draft EIS Comments and FEIS Response

Page T-947: Oregon Comment - *14) Zero Generation Operations measure -this measure will effectively increase ponding during fall/winter periods. Although there will be few juvenile salmonids outmigrating during this period, there are kelt and adult overshoot steelhead that will need to move downstream preferably via spill as opposed to through turbines;*

Response - *The co-lead agencies will implement the zero generation operation in a manner that has negligible effects to any salmon or steelhead present in the river. Nighttime operations will end prior to daylight hours and allow attraction flow to fish ladders to aid passage for fish that are attempting to pass the projects. Daytime zero generation operations will not be implemented until mid-December when juvenile and adult migration has largely ceased. These effects have been qualitatively assessed by the co-lead agencies and will also be reviewed by NMFS and USFWS during the development of their respective Biological Opinions.*

Page T-1001: CTUIR Comment - *There is Unaccounted for Bias or Uncertainty in the Preferred Alternative Analysis The following biases or uncertainties are not addressed or explained: a. Zero Generation in the Snake (as proposed for in the fall in the PA) has not been analyzed; b. Avian losses are not accounted for (see below); c. Significant uncertainty from the Adaptive Management Appendix is not considered and all risk is on the fish side of the equation while minimizing risk on the hydro-power system; and d. Looking at the PA data set in detail, spill plus powerhouse does not always come out the same as the daily average flow, by a large magnitude. Sometimes water disappears and sometimes there is a lot of extra water (more than fishway flows for instance). Due to the uncertainties and modeling biases, significantly more fish mitigation measures should be considered to counter these uncertainties and allow the PA to be consistent with the NPCC goals of 5 million fish and 2-6% SARs.*

Response - *The co-lead agencies will implement the zero generation operation in a manner that has negligible effects to any salmon or steelhead present in the river. Nighttime operations will end prior to daylight hours and allow attraction flow to fish ladders to aid passage for fish that are attempting to pass the projects. Daytime zero generation operations would not be implemented until mid-December when juvenile and adult migration has largely ceased. These effects have been analyzed by the colead agencies and were also reviewed by National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) during the development of their respective Biological Opinions.*

Page T- 1013: NPT Comment - *Effects analyses on zero nighttime flows are not conducted. Current zero nighttime flow operations are implemented no earlier than December 1 and only after low adult steelhead abundance criteria are met. The Preferred Alternative proposes zero nighttime flows starting*

October 15. Analyses must cover impacts to adult migration (not only steelhead, but also fall Chinook and coho salmon) and juvenile migrants (fall Chinook).

Response - *The co-lead agencies will implement the zero generation operation in a manner that has negligible effects to any salmon or steelhead present in the river. Nighttime operations will end prior to daylight hours and allow attraction flow to fish ladders to aid passage for fish that are attempting to pass the projects. Daytime "zero-generation" operations will not be implemented until mid-December when juvenile and adult migration has largely ceased. These affects have been qualitative assessed by the co-lead agencies and will also be reviewed by NMFS and USFWS during the development of their respective Biological Opinions. The Biological Opinions will be appended to the FEIS.*

Page T-1017: NPT Comment - *……..An especially problematic measure in the PA is earlier initiation of Zero Nighttime Flows, as and the work necessary to achieve these metrics have not been coordinated with the Tribe as an on the-ground implementer of projects. These metrics do not allow for meaningful analyses by the Tribe which is most familiar with these efforts, much less the general public. No information is presented that assures that the highest priority limiting factors are being addressed, that projects are feasible to implement, funding is adequate and committed, etc……As noted elsewhere, the DEIS does not contain an analytical construct that allows a measure-specific effects analysis of the PA. o Modelling tools in the EIS are based on daily or monthly averages; PA operation is an hourly operation. o All alternatives, including the PA, must contain a full NEPA effects analysis, to inform decision-makers and the public. The PA fails this requirement. 9 Current Zero Nighttime flow operations are implemented no earlier than December 1 and only after low adult steelhead abundance criteria are met. The PA proposes Zero Nighttime flows starting October 15. Analyses of this operation must cover impacts to adult migration (fall Chinook and coho in addition to steelhead) and juvenile migrants (fall Chinook)……*

Response in Full (no mention of zero Nighttime flows) - *The co-lead agencies are legally obligated to operate and maintain the CRS to meet multiple statutory purposes. They are also required to ensure operation of the CRS complies with other laws. Under the ESA, in particular, the operation of the CRS may not appreciably reduce the likelihood of listed species survival and recovery, or adversely modify or destroy designated critical habitat. The ESA does not, however, require the co-lead agencies to take affirmative actions to recover ESA listed species. The EIS set forth eight objectives which, in tandem with the Purpose and Need Statement, establish the framework for evaluating the ability of an alternative to satisfy the co-lead agencies numerous legal obligations. The Preferred Alternative is predicted to benefit juvenile and adult anadromous salmonids (two of the objectives), but not as much as MO3, which includes breaching the four lower Snake River dams. However, the Preferred Alternative also meets the EIS for resident fish, lamprey, hydropower generation, water management, and water supply, while minimizing adverse effects to communities and the economy. MO3, by contrast, has significant regional economic and community effects, and meets fewer of the EIS objectives. Thus, in the Draft EIS the co-lead agencies did not recommend MO3 which includes breaching the four lower Snake River dams, because the Preferred Alternative is more likely to satisfy multiple complex and at times conflicting legal requirements for a complex system. The EIS concluded MO3, which includes breaching the four lower Snake River dams would have greater improvement to certain salmon species in the lower Snake River. It did not, however, conclude there was greater certainty of that result in MO3 over any other alternative. Because of delayed response time in MO3, and the potential severity of the short term effects, MO3*

would likely have the most substantial uncertainty in terms of beneficial effects. With respect to the Preferred Alternative, the CSS model predicts that average Smolt-to-Adult return rates will increase for both Snake River spring Chinook and steelhead and will average well above 2% (the lower end of Northwest Power and Conservation Council's recovery targets for the region) as a result of the Preferred Alternative, as a result of the Preferred Alternative increasing SAR from 2.0% to 2.7% for Chinook, a 35% relative increase. The NMFS COMPASS and Life Cycle models predict higher levels of risk associated with increased spill levels in the absence of offsets from decreased latent mortality. To address uncertainty highlighted by the two models, the Preferred Alternative includes working with regional sovereigns to develop a study that assess the effectiveness of the increased spill regime on adult returns as well as assessment and management of adverse unintended consequences, such as long delays of adult migrants, or TDG-related mortality of juvenile migrants. See Appendix R, Part 2 Process for Adaptive Implementation of the Flexible Spill Operational Component of the Columbia River System Operations EIS for additional information. Based on the analysis in Section 7.7.4, the co-lead agencies anticipate that the Preferred Alternative would provide substantial benefits to ESA-listed species and is not expected to diminish the likelihood of recovery. Recovery is a broader regional goal and is above and beyond the co-lead agencies obligations under Section 7(a)(2) of the ESA for the effects of operation and maintenance of the CRS. This EIS has been developed in consultation with National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) to find an acceptable balance that allows the co-lead agencies to meet the Purpose and Need Statement while minimizing impacts to affected ESA-listed species and their habitats. Recovery efforts will need to continue to involve parties across the region that have an influence and impact on ESA-listed species. Chapter 8 of the EIS demonstrates the co-lead agencies' compliance with applicable laws, including the ESA and Northwest Power Act. Also, the co-lead agencies relied on high quality, current information in the development of the CRS. The quantity and quality of prey is one of the limiting factors identified by NMFS in recovery of Southern Resident killer whales (SRKWs), along with vessel traffic and noise, and toxic contaminants. The overall health and condition of the Southern Resident Killer Whale (SRKW) depends on the availability of a variety of fish populations throughout their range. SRKW are Chinook specialists, but also consume other available prey populations while they move through various areas of their range in search of prey. NMFS and WDFW have developed a prioritized list of Chinook salmon within their range that are important to SRKW, to help prioritize actions to increase prey availability for whales (NOAA and WDFW 2018).This list includes many Columbia River Basin Chinook salmon stocks including Lower Columbia fall run (tules and brights), Upper Columbia and Snake fall-run (Upriver Brights), Lower Columbia River spring-run, Middle Columbia River fall run, and Snake River spring/summer-run. Southern Residents also are known to eat some steelhead, coho, and chum salmon, and halibut, lingcod, and big skate while in coastal waters. The diet is dominated by Chinook salmon both in coastal waters and within the Salish Sea; SRKWs are opportunistic feeders that follow the most abundant Chinook salmon runs throughout their range from the west side of Vancouver Island to the central California coast. There is no evidence that SRKWs feed or benefit differentially between wild and hatchery Chinook salmon. Snake River spring/summer Chinook salmon is a small portion of SRKW overall diet, but can be an important forage species during late winter and early spring months near the mouth of the Columbia River (Ford 2016).The operation of the Columbia River System directly affects Chinook salmon, both wild and hatchery origin fish, which migrate past these federal dam and reservoir projects, and the associated effects would indirectly affect SRKWs. However, according to NMFS, in terms of the overall abundance of Chinook salmon available to SRKW for prey, numbers of adults from the Snake River Basin (including both hatchery and wild produced fish) are now

greater than they were in the 1960s, before three of the four lower Snake River dams were built. NMFS maintains that hatcheries produce more than enough Chinook salmon in the

Columbia River basin to offset losses caused by the dams. So far as researchers can determine, SRKW do not distinguish between or benefit differentially from hatchery and wild fish. Hatchery fish today likely make up most fish consumed by SRKW (NOAA BiOp2020). The co-lead agencies note the contribution to the prey of SRKW through the continued existence of their respective independent congressionally authorized hatchery mitigation responsibilities, including, but not limited to, Grand Coulee mitigation, John Day mitigation and programs funded and administered by other entities, such as the Lower Snake River Compensation Plan, which is administered by U.S. Fish and Wildlife Service. The Preferred Alternative carries forward certain mitigation measures described in Chapters 2 and 7 of the EIS, which include continued salmon and steelhead hatchery production. The Preferred Alternative has negligible effects to SRKWs as described in Section 7.7.8 in large part because hatchery production is consistent between the No Action Alternative and the Preferred Alternative. The FEIS includes additional information on SRKWs in Section 3.6 and7.7.8. Finally, funding decisions for the Bonneville Fish and Wildlife (F&W) Program are not being made as a part of the CRSO EIS process. However, a range of potential F&W program costs are included to inform the broader cost analysis for each alternative in the EIS. In the case of the Preferred Alternative, Bonneville included a range of potential F&W program costs to acknowledge the possibility that the Preferred Alternative could provide biological benefits to anadromous fish species (see Chapter 7 of the EIS, Preferred Alternative) and that this could, in turn, reduce the need for some offsite mitigation funded through the Bonneville F&W Program. By analyzing a range of costs, Bonneville reflects the year-to-year fluctuations related to managing its program and also acknowledges the uncertainty around both the magnitude of biological benefits and the potential impacts on funding, including the timing of funding decisions. Future budget adjustments would be made in consultation with the region through Bonneville's budget-making processes and other appropriate forums and consistent with existing agreements. As discussed in section 7.7.21.1, in 2016, Bonneville's F&W Program budget was $267,000,000, and the Lower Snake River Compensation Plan (LSRCP) budget was $32,303,000. When these budgets are adjusted to represent 2019 dollars, they become $281,536,000 and $34,062,000, respectively, which are the budgets used under the No Action Alternative. For the Preferred Alternative, Bonneville would continue funding the operations and maintenance of the LSRCP, consistent with the No Action Alternative. Bonneville's F&W Program costs under the Preferred Alternative are estimated to range from no change from the No Action Alternative to a decrease of approximately 17%, or approximately $47 million, annually. Bonneville's fiscal year 2020 decisions to adjust the F&W Program budget to $249 million and the LSRCP budget to $30.5 million (BP-18 Rate Case) are consistent with the range of costs analyzed for the Preferred Alternative. With regard to benefits of ongoing mitigation actions, section 2.4.2 provides a high-level overview of Bonneville's Fish and Wildlife Program, many of its major subprograms and their benefits, including habitat actions, hatchery actions, predator management, lamprey research and mitigation, and wildlife mitigation. Section 2.4.2 also describes some of the many CRS improvements and the associated benefits for fish. The fish and wildlife mitigation projects that Bonneville funds have been recommended by the Northwest Power and Conservation Council (Council) and either derive from, or have been incorporated into, the Councils Columbia River Basin Fish and Wildlife Program. Further, the Independent Scientific Review Panel periodically reviews the mitigation projects under certain statutory criteria such as benefits to fish and wildlife.16 U.S.C. 839b(h)(10)(D(iv). And for fish and wildlife managers that implement Northwest Power Act mitigation through Fish Accord agreements with the co-lead agencies, the managers and co-

lead agencies have agreed that such mitigation projects are consistent with the Councils Fish and Wildlife Program. See responses to Comments 31775-51, 6894-56, and 6894-49. With regard to the comments about the policies and mandates of the Northwest Power Act, the FEIS has been edited to provide more detailed discussion of those mandates and how the Agencies comply with them. See Chapter 5.1.2.

Page T-1055: CRITFC Comment - *Fall-time zero generation (zero flow) in the Snake (effects unknown on adult fall chinook, steelhead, and coho, and on juvenile fall chinook) with no mitigation proposed;*

Response - *Extending the zero generation operation measure would not affect juvenile salmon or steelhead because they are not migrating in the late fall/winter timeframe when this measure occurs. However, impacts to adult passage (especially for Snake River steelhead) may be anticipated due to this operation. Because of the short overlap with the adult fish migration period, and limiting the operation to nighttime hours, this effect was considered to be minor. As with other operational measures in the Preferred Alternative, the impacts of the zero generation operation measure will be evaluated through the Regional Forum and adaptively managed as needed. In this EIS process, the co-lead agencies only develop mitigation for measures that result in moderate to major effects as compared to the No Action Alternative.*

Final EIS Preferred Alternative

- "Zero Generation Operation" – Operational measure listed on page 7-25.
- 7.6.3.14 Zero Generation Operations (Page 7-38) - *This measure was modified from MO2. This action would expand the ability of the Corps to temporarily stop flows through the turbines on the lower Snake River projects. These operations would be undertaken when there is little demand for hydropower, unless limited by grid stability requirements. This measure would allow operators to save water in low demand periods to use for hydropower generation during high demand periods. Currently, these projects are allowed to operate at Zero Generation from early or mid-December through February 28 (based on an implementation trigger). The updated operation would begin as early as October 15 and could continue through February 28, when power markets warrant and when river conditions make it feasible. These operations would be implemented at night only from October 15 to November 30 and would cease 2 hours before dawn to reestablish flows for adult salmon migration upstream during the day. Between December 1 and February 28 this operation could also be implemented for up to 3 hours daily during the daylight hours. These dates were selected to minimize effects to anadromous salmon and steelhead.*
- No description of adult Snake River steelhead migration/survival effects from extended 'zero generation operation.'
- Effects description on Snake River adult coho provided on pages 7-109 and 7-110 – "*Zero nighttime generation on the Snake River may delay later migrating Snake River coho salmon, but shaping this operation to occur only at night is expected to minimize this effect (Liscom, Stuehrenberg, and Ossiander 1985)."* Hesse NOTE: Liscom et al (1985) was limited to chinook and steelhead during July, August, and September.

- No change is anticipated in Snake River fall Chinook juvenile rearing habitat (page 7-111).
- No mention of the 'zero generation operation' on Snake River fall Chinook juvenile fish migration/survival (page 7-111).
- Effects description on Snake River adult fall Chinook provided on pages 7-109 and 7-111 and 112 – *"Zero generation operation could delay Snake River fall Chinook migrating in the Lower Snake River after October 15 (Liscom, Stuehrenberg, and Ossiander 1985) but shaping this operation to occur only at night during the adult migration period is expected to minimize this effect."* Hesse NOTE: Liscom et al (1985) was limited to chinook and steelhead during July, August, and September.
- Collective operational measures, including 'zero generation operations', are described (page 7-150) as "could improve fish passage times….". While potentially accurate for the collective suite of measures, the limited analysis provided of 'zero generation operations' indicate delayed fish passage, not improved.
- No analysis within FEIS Fish, Aquatic Macroinvertebrates, and Aquatic Habitat Appendix E.

Biological Assessment (FEIS Appendix V Part 1).

- Description of zero generation operations on pages 2-64 and 2-65 – "*Between October 15 and February 28, when power market conditions warrant and when river conditions make it feasible, power generation at Snake River projects may cease during nighttime hours, most commonly implemented between 2300 and 0500 hours when demand for power is lowest and other renewable resources are generating surplus power (or both). This operation will end no later than 2 hours before dawn between October 15 and November 30. During the operation between December 15 and February 28, daytime hours will no longer be excluded from this operation, and up to 3 hours of daytime cessation will be part of the Proposed Action. This shift in current operation would allow operators to save water in low demand periods to use for hydropower generation during higher demand periods. The timing and need for ceasing power generation during this period of time is difficult to predict. However, based on previous operations between December 15 and February 28 and during nighttime hours only, Bonneville estimates the use of this operation may occur one out of every 3 to 5 days at each project. See the WMP[21] for additional details."*
    - [21] Water Management Plan (http://pweb.crohms.org/tmt/documents/wmp/2020/)
        - Hesse NOTE: The 2020 WMP describes zero generation operations in the seasonal update as being guided by SOR 2005-22 abundance criteria. The seasonal update shows implementation occurred on >70% of the available days with several extended periods of repeated implementation, exceeding the BA estimated occurrence frequency of 1 to 3 days out of 5. The 2021 Draft WMP (just posted Oct 1, 2020) describes Snake River Zero Generation operations in section 6.10.2 - *The four lower Snake River projects may cease hydropower generation during the dates and times defined below when power market conditions warrant and when river conditions make it feasible to store water during low demand periods for use during higher demand periods:*
            - *October 15 - November 30: Nighttime hours, most commonly 2300-0500 (ending no later than 2 hours before dawn).*
            - *December 1-14: Nighttime hours, most commonly 2300-0500.*

- *December 15 - February 28: Nighttime hours, most commonly 2300-0500, and up to 3 daytime hours.*
- *This operation is pursuant to the AAs' Proposed Action in the 2020 CRS BA, page 2-64, and analyzed in the 2020 NMFS BiOp, page 944, and the 2020 USFWS BiOp, page 212.*
    - Hesse Note: The referenced BiOp pages only address Mid Columbia adult steelhead and should also include pages 611 and 615.

Biological Opinions (FEIS Appendix V Part 2 - NOAA)

- Description of zero generation operations on pages 63 and 64, section 1.3.1.3.3 - *In the Pacific Northwest, energy demands have typically peaked in the wintertime as the need for heating increases, and ensuring a sufficient supply of electricity in the winter can be a challenge, particularly when demand increases dramatically region-wide and little or no electricity is available in the wholesale market during cold temperature events. Because most renewable resources generate power when the wind blows or the sun shines, regardless of when residents and businesses in the Northwest need the electricity, other generators (typically hydropower and gas-fired power plants) must adjust their power generation to compensate for fluctuations in energy produced by these variable resources (i.e., to integrate the renewable power sources). Within normal operating limits and other project requirements, BPA uses the capacity of the CRS projects to support the integration of these additional carbon-free energy resources into the regional and western electrical grid. This ancillary service provided by the CRS is becoming increasingly important as more wind and solar power sources come online in the Pacific Northwest. A key component of how wind and solar power resources are integrated into the CRS is the flexibility to cease power generation when there is little demand.*

  Between October 15 and February 28, when power market conditions warrant and when river conditions make it feasible, power generation at Snake River projects may cease, and water stored, during nighttime hours, most commonly implemented between 2300 and 0500 hours when demand for power is lowest or other renewable resources are generating surplus power (or both). This operation will end no later than 2 hours before dawn between October 15 and November 30. During the operation between December 15 and February 28, daytime hours will no longer be excluded from this operation, and up to 3 hours of daytime cessation will be part of the proposed action. This shift in current operation would allow operators to save water in low demand periods to use for hydropower generation during higher demand periods. The timing and need for ceasing power generation during this period is difficult to predict. However, based on previous operations between December 15 and February 28 and during nighttime hours only, BPA estimates that the use of this operation may occur 1 out of every 3 to 5 days at each project. See the BA (BPA et al. 2020) and water management plan for additional details.

- Zero generation operation impacts on adult fall Chinook are described on page 611 - *Power generation at Snake River projects may cease between 2300 and 0500 hours between October 15 and February 28. This operation will end no later than 2 hours before dawn between October*

15 and November 30. During the operation between December 15 and February 28, daytime hours will no longer be excluded from this operation, and up to 3 hours of daytime cessation may occur. PIT-tag and passage data indicate that fewer than 10 percent of adult SR fall Chinook salmon migrate through the Snake River during this time period, so we expect there could be a small (hours or days) effect on adult migration timing for these individuals, but we would not expect these delays to measurable impact adult survival rates.

- Effects of zero nighttime generation and extended closure of Lower Granite and Little Goose fish ladders on adult steelhead are not assessed or even mentioned.

- Zero generation operation impacts on juvenile fall Chinook are described on page 615 - *Power generation at Snake River projects may cease between 2300 and 0500 hours between October 15 and February 28. This operation will end no later than 2 hours before dawn between October 15 and November 30. During the operation between December 15 and February 28, daytime hours will no longer be excluded from this operation, and up to 3 hours of daytime cessation may occur. These operations will result in no flow past the projects in the Snake River during these periods. Some overwintering juvenile fall Chinook are expected to be in the lower Snake River during this period, however, these temporary flow changes are not expected to measurably affect the juvenile migration timing or survival of these fish.*

  Power generation at Snake River projects may cease for short periods between October 15 and February 28 and will result in no flow past the projects in the Snake River during these periods. Zero or very few SR fall Chinook salmon juveniles are expected to be actively migrating through the lower Snake River during this period, so this operation will have no measurable effect.

    - The NOAA Biological Opinion does not provide any quantitative analysis of zero generation impacts and qualitative conclusions are limited to juvenile Snake River fall Chinook and based upon inaccurate assessments of juvenile emigration timing. Emigration/movement of juvenile fall Chinook past Snake River dams after August 31st is missing in the Biological Opinion (Section 2.5.3.1.1).

- Zero generation operation impacts on adult Mid-Columbia steelhead are described on page 944 - *Power generation at Snake River projects may cease between 2300 and 0500 hours between October 15 and February 28. This operation will end no later than 2 hours before dawn between October 15 and November 30. During the operation between December 15 and February 28, daytime hours will no longer be excluded from this operation, and up to 3 hours of daytime cessation may occur. PIT-tag data indicate that some adult MCR steelhead will migrate through and overwinter in the Snake River during this operation, but past zero generation operations have not produced observably negative impacts for MCR steelhead, so we expect that this operation will not negatively affect adult migration or survival for this ESU.*

Biological Opinions (FEIS Appendix V Part 3 - USFWS)

Extension of Zero Generation Operations described in section 5.1.4.3, page 24 - *In the Pacific Northwest, energy demands have typically peaked in the wintertime as the need for heating increases. Ensuring a sufficient supply of electricity in the winter can be a challenge, particularly when demand increases dramatically region-wide and little or no electricity is available in the wholesale market during cold temperature events. Because most renewable resources generate when the wind blows or the sun shines, regardless of when residents and businesses in the Northwest need the electricity, other generators (typically hydropower and gas fired power plants) must adjust their power generation to compensate for fluctuations in energy produced by these variable resources (i.e., to integrate the renewable power sources). Within normal operating limits and other project requirements, Bonneville uses the capacity of the CRS projects to support the integration of these additional carbon-free energy resources into the regional and western electrical grid. This ancillary service provided by the CRS is becoming increasingly important as more wind and solar power sources come online in the Pacific Northwest. A component of how wind and solar power resources are integrated into the CRS includes the flexibility to cease power generation when there is little demand. Between October 15 and February 28, when power market conditions warrant and when river conditions make it feasible, power generation at Snake River projects may cease, and water stored, during nighttime hours, most commonly implemented between 2300 and 0500 hours when demand for power is lowest and other renewable resources are generating surplus power (or both). During this time, river flow occurs through operation of passage facilities only. This operation will end no later than 2 hours before dawn between October 15 and November 30. During the operation between December 15 and February 28, daytime hours will no longer be excluded from this operation, and up to 3 hours of daytime cessation will be part of the Proposed Action. This shift in current operation would allow operators to save water in low demand periods to use for hydropower generation during higher demand periods. The timing and need for ceasing power generation during this period of time is difficult to predict. However, based on previous operations between December 15 and February 28 and during nighttime hours only, Bonneville estimates the use of this operation may occur one out of every 3 to 5 days at each project. See the biological assessment (Corps et al. 2020a) and Water Management Plan for additional details.*

Page 212 - *Delays in migration and movement of bull trout are expected from operation and maintenance activities at passage facilities annually. Impacts of salvage and fish handling for dewatering activities is discussed later. During passage facility maintenance, the passage facilities are dewatered and there is a barrier to movement for bull trout. Maintenance closures will result in complete passage barriers at Lower Granite and Little Goose dams annually for up to two months. In addition, a single upstream passage facility at each of the other dams will close for annual maintenance for up to two months. It is unknown if bull trout prefer north or south side passage facilities. At other projects across the region, attraction flow to passage facilities is key to use by bull trout. It could be assumed that depending on the combination of passage facility source flows and spillway or turbine flows (such as during zero generation operations), bull trout may have lowered abilities to locate passage facilities during annual maintenance or during zero generation operations (Corps et al 2020a p. 2-54; 7-37). Since bull trout are using the river primarily for foraging and overwintering during annual fish passage maintenance (December through February) or zero generation operations (October through*

February), the Service expects non-lethal behavioral impacts in the form of delayed movements and reduced access to forage areas for all bull trout in the river at that time.

Record of Decision

Page 60; Section 6.3.1.1.5 Zero Generation - *Generating hydropower to meet demand in the winter in the Pacific Northwest can be a challenge when demand can increase dramatically and there is little additional electricity available due to adjustments in power generation in order to integrate variable renewable resources. Therefore, Bonneville has and will continue to use the capacity of the CRS to support the flexibility necessary for this integration and has proposed an expansion of that capacity under limited circumstances. Between October 15 and February 28, power generation may cease at the four lower Snake River projects and water may be stored during nighttime hours (2300 to 0500) when adult fish are typically not passing. This operation will end no later than 2 hours before dawn to facilitate adult upstream passage, which generally resumes as the sun rises. Between December 15 and February 28, a period of time when water temperatures are low and very few adult fish are still migrating in the river, daytime hours will no longer be excluded from this operation, and up to 3 hours of daytime cessation may occur. NMFS found that Passive Integrated Transponder (PIT)-tag data indicated that some adult Middle Columbia River steelhead will migrate through and overwinter in the lower Snake River during this operation (as will bull trout), but past zero generation operations have not produced observably negative impacts for Middle Columbia River steelhead.*[156] *It is expected that this operation will not appreciably reduce the likelihood of survival and recovery for these fish.*